VALIDATION OF A MASS CASUALTY MODEL

By

Joan M. Culley

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SIGNED: Joan M. Culley
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My husband Sal who provides a reality check when I feel hopeless and overwhelmed.
DEDICATION

As I have walked along the sandy beaches of life, I noticed that at times there were two sets of footprints, and at other times there was only one. The journey has been long and tortuous with many surprises, blessings and deep tragedy. All of these experiences shape who I am, what I believe, the values that I hold dear, and the paths I have taken on this journey. I have not taken this passage alone. Family, friends, colleagues, faculty and God have guided my steps, providing support, motivation, discipline, reassurance, comfort and the drive to believe in myself. At times I have felt so alone but as I look back in the sands of time, I realize that parallel footprints, were family, friends and colleagues that walked beside me helping me to stand on my own two feet. While the one set of prints did not always occur at the times that I felt I need carrying the most, I realize that we all approach life with enormous potential but must be willing to take the risk that we will be carried when needed. The willingness to risk has the potential to bring growth and wonder to life’s journey.

I dedicate this work of passion and love to my dearest friend, companion, soul mate, research assistant and husband, Salvatore DiNardi. You are the love of my life and my inspiration. Thank you for believing in me when I could not believe in myself.
# TABLE OF CONTENTS

| LIST OF FIGURES | .......................................................... | 9 |
|-----------------|..................................................................|---|
| LIST OF TABLES | ..................................................................| 10 |
| CHAPTER I: DESCRIPTION OF THE WORK | .......................................................... | 13 |
| Introduction | .................................................................. | 13 |
| Disaster Responses to Mass Casualty Events | .......................................................... | 13 |
| Purpose | .................................................................. | 17 |
| Research Questions | .................................................................. | 17 |
| Significance | .................................................................. | 19 |
| Summary | .................................................................. | 20 |
| CHAPTER II: THEORETICAL PERSPECTIVE | .......................................................... | 21 |
| Introduction | .................................................................. | 21 |
| Synthesis of Previous Mass Casualty Research | .......................................................... | 21 |
| Theoretical Underpinnings of the MCCM | .......................................................... | 25 |
| Influences of Environmental Systems Theories on the Model | .......................................................... | 33 |
| Structural Contingency Theory | .................................................................. | 33 |
| Technology Theory | .................................................................. | 36 |
| Influences of Informatics Models | .................................................................. | 38 |
| Human Factors Influences | .................................................................. | 38 |
| Conclusion | .................................................................. | 42 |
| CHAPTER III: METHODOLOGY | .......................................................... | 43 |
| Delphi Process | .................................................................. | 43 |
| Consensus | .................................................................. | 44 |
| Feedback | .................................................................. | 46 |
| Expert Panel | .................................................................. | 47 |
| Anonymity | .................................................................. | 48 |
| Computer Applications | .................................................................. | 48 |
| Modified Delphi Process | .................................................................. | 49 |
| Research Design and Methods | .................................................................. | 50 |
| Sample | .................................................................. | 51 |
| Communication Technology | .................................................................. | 53 |
| Procedure | .................................................................. | 54 |
| Data Management | .................................................................. | 56 |
| Data Analysis | .................................................................. | 56 |
| Human Subjects Protection | .................................................................. | 57 |
| Limitations | .................................................................. | 58 |
| Summary | .................................................................. | 59 |
| CHAPTER IV: RESULTS | .......................................................... | 60 |
| Introduction | .................................................................. | 60 |
| Sample Characteristics | .................................................................. | 60 |
| Round One of the Delphi Process | .................................................................. | 62 |
# TABLE OF CONTENTS - Continued

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round Two of the Delphi Process</td>
<td>63</td>
</tr>
<tr>
<td>Summary of Data from Round One and Round Two of the Delphi Process</td>
<td>64</td>
</tr>
<tr>
<td>Comments Related to Constructs</td>
<td>73</td>
</tr>
<tr>
<td>Comments Related to Relationships</td>
<td>73</td>
</tr>
<tr>
<td>Comments Related to Indicators for Each Construct</td>
<td>74</td>
</tr>
<tr>
<td>Organizational Customs Indicators</td>
<td>74</td>
</tr>
<tr>
<td>Environmental Context Indicators</td>
<td>75</td>
</tr>
<tr>
<td>Resources Indicators</td>
<td>75</td>
</tr>
<tr>
<td>Workforce Indicators</td>
<td>76</td>
</tr>
<tr>
<td>Information Technology (Technology) Indicators</td>
<td>76</td>
</tr>
<tr>
<td>Information Technology (Information) Indicators</td>
<td>77</td>
</tr>
<tr>
<td>Structure Indicators</td>
<td>77</td>
</tr>
<tr>
<td>Triage Indicators</td>
<td>77</td>
</tr>
<tr>
<td>Outcomes Indicators</td>
<td>78</td>
</tr>
<tr>
<td>Comments Related to Constructs</td>
<td>78</td>
</tr>
<tr>
<td>Comments Related to Relationships</td>
<td>79</td>
</tr>
<tr>
<td>Comments Related to Indicators for Each Construct</td>
<td>79</td>
</tr>
<tr>
<td>Organizational Customs Indicators</td>
<td>79</td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity Indicators</td>
<td>80</td>
</tr>
<tr>
<td>Environmental Context Indicators</td>
<td>80</td>
</tr>
<tr>
<td>Patients Indicators</td>
<td>81</td>
</tr>
<tr>
<td>Workforce Indicators</td>
<td>81</td>
</tr>
<tr>
<td>Information Technology (Technology) Indicators</td>
<td>81</td>
</tr>
<tr>
<td>Structure Indicators</td>
<td>81</td>
</tr>
<tr>
<td>Outcomes Indicators</td>
<td>82</td>
</tr>
<tr>
<td>Summary of Comments</td>
<td>82</td>
</tr>
<tr>
<td>Usefulness of the Model and Online Delphi Process</td>
<td>91</td>
</tr>
<tr>
<td>Summary of Comments</td>
<td>94</td>
</tr>
<tr>
<td>CHAPTER V: DISCUSSION AND RECOMMENDATIONS</td>
<td>95</td>
</tr>
<tr>
<td>Introduction</td>
<td>95</td>
</tr>
<tr>
<td>Discussion of Results and Implications</td>
<td>96</td>
</tr>
<tr>
<td>Research Question One</td>
<td>99</td>
</tr>
<tr>
<td>Research Question Two</td>
<td>99</td>
</tr>
<tr>
<td>Research Question Three</td>
<td>102</td>
</tr>
<tr>
<td>Organizational Customs Indicators</td>
<td>102</td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity Indicators</td>
<td>103</td>
</tr>
<tr>
<td>Environmental Context Indicators</td>
<td>105</td>
</tr>
<tr>
<td>Patient Indicators</td>
<td>106</td>
</tr>
<tr>
<td>Resources Indicators</td>
<td>108</td>
</tr>
<tr>
<td>Workforce Indicators</td>
<td>109</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS - Continued

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology (Technology) Indicators</td>
<td>110</td>
</tr>
<tr>
<td>Information Technology (Information) Indicators</td>
<td>111</td>
</tr>
<tr>
<td>Structure Indicators</td>
<td>112</td>
</tr>
<tr>
<td>Triage Indicators</td>
<td>113</td>
</tr>
<tr>
<td>Outcomes (Patients) Indicators</td>
<td>114</td>
</tr>
<tr>
<td>Outcomes (Resource) Indicators</td>
<td>114</td>
</tr>
<tr>
<td>Research Question Four</td>
<td>115</td>
</tr>
<tr>
<td>Usefulness of the Online Processes Employed in the Delphi Process</td>
<td>116</td>
</tr>
<tr>
<td>Limitations</td>
<td>118</td>
</tr>
<tr>
<td>Future Areas for Research</td>
<td>119</td>
</tr>
<tr>
<td>Summary</td>
<td>121</td>
</tr>
<tr>
<td>APPENDIX A: VICENTE’S MODEL APPLIED TO THE MCCM</td>
<td>123</td>
</tr>
<tr>
<td>APPENDIX B: INITIAL EMAIL TO POTENTIAL PANEL MEMBERS</td>
<td>129</td>
</tr>
<tr>
<td>APPENDIX C: DISCLAIMER FORM</td>
<td>131</td>
</tr>
<tr>
<td>APPENDIX D: PANEL PROFILE SURVEY</td>
<td>135</td>
</tr>
<tr>
<td>APPENDIX E: REVISED DISCLAIMER FORM</td>
<td>139</td>
</tr>
<tr>
<td>APPENDIX F: EMAIL DIRECTING PANEL MEMBERS TO STUDY WEB PAGE</td>
<td>144</td>
</tr>
<tr>
<td>APPENDIX G: WEB PAGE DESIGNED FOR THE STUDY</td>
<td>146</td>
</tr>
<tr>
<td>APPENDIX H: NARRATED PRESENTATION-DELPHI PROCESS</td>
<td>148</td>
</tr>
<tr>
<td>APPENDIX I: NARRATED PRESENTATION-EXPLANATION OF THE MCCM</td>
<td>153</td>
</tr>
<tr>
<td>APPENDIX J: GLOSSARY OF TERMS RELATED TO THE MCCM</td>
<td>168</td>
</tr>
<tr>
<td>APPENDIX K: FIRST ROUND QUESTIONNAIRE</td>
<td>177</td>
</tr>
<tr>
<td>APPENDIX L: SECOND ROUND QUESTIONNAIRE</td>
<td>187</td>
</tr>
<tr>
<td>APPENDIX M: SURVEYMONKEY DATA SECURITY INFORMATION</td>
<td>197</td>
</tr>
<tr>
<td>APPENDIX N: EMAIL REGARDING FEEDBACK FROM ROUND ONE</td>
<td>199</td>
</tr>
<tr>
<td>APPENDIX O: FEEDBACK FROM ROUND ONE</td>
<td>201</td>
</tr>
<tr>
<td>APPENDIX P: EMAIL REGARDING FEEDBACK FROM ROUND TWO</td>
<td>243</td>
</tr>
<tr>
<td>APPENDIX Q: FEEDBACK FROM ROUND TWO</td>
<td>245</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>284</td>
</tr>
</tbody>
</table>
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Mass Casualty Conceptual Model (MCCM)</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Influence of the Three Theories/Models on the MCCM</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>MCCM Stage I: Contextual Environment - Organizational Customs and Triage Unit Organizational Complexity</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>MCCM Stage I: Contextual Environment - Environmental Context</td>
<td>28</td>
</tr>
<tr>
<td>5</td>
<td>MCCM Stage I: Contextual Environment - Patients, Resources and Workforce</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>MCCM Stage II: Information Environment</td>
<td>31</td>
</tr>
<tr>
<td>7</td>
<td>MCCM Stage III: Structural Environment</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>MCCM Stage IV: Triage</td>
<td>32</td>
</tr>
<tr>
<td>9</td>
<td>MCCM Stage V: Goals</td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>Validated Mass Casualty Conceptual Model (MCCM)</td>
<td>83</td>
</tr>
<tr>
<td>11</td>
<td>Validated MCCM Stage I: Contextual Environment - Organizational Customs</td>
<td>84</td>
</tr>
<tr>
<td>12</td>
<td>Validated MCCM Stage I: Contextual Environment - Triage Unit Organizational Complexity</td>
<td>85</td>
</tr>
<tr>
<td>13</td>
<td>Validated MCCM Stage I: Contextual Environment - Environmental Context</td>
<td>86</td>
</tr>
<tr>
<td>14</td>
<td>Validated MCCM Stage I: Contextual Environment - Patients, Resources and Workforce</td>
<td>87</td>
</tr>
<tr>
<td>15</td>
<td>Validated MCCM Stage II: Information Environment</td>
<td>88</td>
</tr>
<tr>
<td>16</td>
<td>Validated MCCM Stage III: Structural Environment</td>
<td>89</td>
</tr>
<tr>
<td>17</td>
<td>Validated MCCM Stage IV: Triage</td>
<td>89</td>
</tr>
<tr>
<td>18</td>
<td>Validated MCCM Stage V: Goals</td>
<td>90</td>
</tr>
<tr>
<td>19</td>
<td>Usefulness of the Model to Further Research</td>
<td>92</td>
</tr>
<tr>
<td>20</td>
<td>The Validated Mass Casualty Conceptual Model (MCCM)</td>
<td>100</td>
</tr>
<tr>
<td>21</td>
<td>Organizational Customs Indicators</td>
<td>103</td>
</tr>
<tr>
<td>22</td>
<td>Triage Unit Organizational Complexity Indicators</td>
<td>105</td>
</tr>
<tr>
<td>23</td>
<td>Environmental Context Indicator</td>
<td>106</td>
</tr>
<tr>
<td>24</td>
<td>Patient Indicators</td>
<td>108</td>
</tr>
<tr>
<td>25</td>
<td>Resources Indicators</td>
<td>109</td>
</tr>
<tr>
<td>26</td>
<td>Workforce Indicators</td>
<td>110</td>
</tr>
<tr>
<td>27</td>
<td>Information Technology (Technology) Indictors</td>
<td>111</td>
</tr>
<tr>
<td>28</td>
<td>Information Technology (Information) Indictors</td>
<td>112</td>
</tr>
<tr>
<td>29</td>
<td>Structure Indictors</td>
<td>113</td>
</tr>
<tr>
<td>30</td>
<td>Triage Indictors</td>
<td>113</td>
</tr>
<tr>
<td>31</td>
<td>Outcomes (Patients) Indictors</td>
<td>114</td>
</tr>
<tr>
<td>32</td>
<td>Outcomes (Resource and Safety) Indictors</td>
<td>115</td>
</tr>
<tr>
<td>33</td>
<td>Usefulness of Items in the Online Delphi Process</td>
<td>117</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1. Influences of Structural Contingency Theory on the MCCM ....................... 39
Table 2. Influences of Technology Theory on the MCCM .......................................... 40
Table 3. Demographic Characteristics Related to Gender, Age, Expertise and Years
    Employed in Emergency Preparedness ..................................................................... 61
Table 4. Demographic Characteristics Related to Gender and Highest Degree Earned... 61
Table 5. Demographic Characteristics Related to Gender and Area of Responsibility.... 62
Table 6. Demographic Characteristics Related to Gender and Geographic Zone .......... 62
Table 7. Mean Responses, Interquartile Ranges, Percent Stability and Status of
    Consensus/Stability Related to the Constructs ....................................................... 65
Table 8. Mean Responses, Interquartile Ranges, Percent Stability and Status of
    Consensus/Stability for Relationships ................................................................. 66
Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability for
    Indicators for Each Construct ............................................................................. 67
Table 10. Mean Responses Related to the Usefulness of the Online Processes .......... 91
ABSTRACT

There is a paucity of literature evaluating mass casualty systems and no clear ‘gold standard’ for measuring the efficacy of information decision support systems or triage systems that can be used in mass casualty events. The purpose of this research was the preliminary validation of a comprehensive conceptual model for a mass casualty continuum of care. This research examined key relationships among entities/factors needed to provide real-time visibility of data that track patients, personnel, resources and potential hazards that influence outcomes of care during mass casualty events.

A modified Delphi technique was used to validate the proposed model using a panel of experts. The four research questions measured the extent to which experts agreed that the: 1) ten constructs represent appropriate predictors of outcomes of care during mass casualty events; 2) proposed relationships among the constructs provide valid representations of mass casualty triage; 3) proposed indicators for each construct represent appropriate measurements for the constructs; and 4) the proposed model is seen as useful to the further study of information and technology requirements during mass casualty events. The usefulness of the online Delphi process was also evaluated.

A purposeful sample of 18 experts who work in the field of emergency preparedness/response was selected from across the United States. Computer, Internet and email applications were used to facilitate a modified Delphi technique through which experts provided initial validation for the proposed conceptual model. Two rounds of the Delphi process were needed to satisfy the criteria for consensus and/or stability related to the constructs, relationships and indicators in the model. Experts viewed the proposed
model as relatively useful (Mean = 5.3 on a 7-point scale). Experts rated the online Delphi process favorably.

Constructs, relationships and indicators presented in this model are viewed as preliminary. Future research is needed to develop the tools to measure the constructs and then test the model as a framework for studying effects and outcomes of mass casualty events. This study provides a foundation for understanding the complex context in which mass casualty events take place and the factors that influence outcomes of care.
CHAPTER I: DESCRIPTION OF THE WORK

Introduction

Events such as hurricane disasters, tsunamis and the 2001 attacks on the World Trade Center and Pentagon clearly illustrate the inadequacy of current mass casualty response systems. Effective disaster response to mass-casualty incidents represents one of the greatest challenges to our nation’s emergency response infrastructure. The purpose of this research was to provide a comprehensive conceptual model for mass casualty events. Chapter 1 provides an overview of the problem and defines the purpose of the research, as well as the research questions to be answered. In addition, the potential significance of the study is described.

Disaster Responses to Mass Casualty Events

The United States faces an uncertain future clouded by the persistent threat of terrorist actions, as well as the management of large numbers of seriously injured patients that could be expected during catastrophic events - either from natural, unintended or deliberate incidents (Fry & Lenert, 2005; Perrow, 2006; Simon & Teperman, 2001; Sundnes & Birnbaum, 2003). Such events could produce large numbers of casualties that would overwhelm existing healthcare facilities, jeopardizing the lives of victims and healthcare providers.

Mass casualty incidents require that response coordinators have sufficient information on which to base their understanding (frequently referred to as “situational awareness”) of the event as it evolves. Situational awareness refers to the ability to make timely, effective decisions during rapidly evolving events. When situational awareness is
lost, supervisors are forced to make resource allocation decisions without adequate information, which leads to the sub-optimal utilization of staff and equipment and ultimately to poor patient outcomes. Thus, the availability of timely, accurate information about patients, resources, and environmental conditions is key to effective coordination and management of mass casualty events.

Mass casualty events include natural, unintended and deliberate incidents that occur with little or no warning and have the potential to produce large numbers of casualties that can overwhelm existing healthcare facilities and resources. These are commonly described as “all hazards events,” but for the purposes of this study, are called “mass casualty events” or “events.” The Centers for Disease Control and Prevention (CDC website) describe a mass casualty incident as an event involving six or more casualties. Responses to mass casualty events involve a complex interplay of variables based on systems with unique characteristics, requirements and structures, as shown in the following:

System characteristics of mass casualty events include the environmental factors that initiate and influence the events, as well as the patients affected by the event, and the resources available to affect survivability. Requirements involve the information and technology necessary to control work flow and support an appropriate work flow design that matches the skill mix and experience of the available workforce. Structure can be understood as the Incident Command Structure (ICS) management system used in the United States and other countries to organize scalable emergency responses to incidents of any magnitude. The ICS system is activated in any emergency situation and establishes
the organizational structure that brings together a workforce from multiple disciplines such as police, fire, rescue, medicine, nursing, public health, and other disciplines in a mass casualty event (Department of Homeland Security Federal Emergency Management Agency website).

Within the ICS structure, the primary goal of a mass casualty triage structure is to identify the optimal resources required to adequately and efficiently treat patients that have the greatest chance for survival with healthcare intervention. Triage of casualties must be performed accurately and efficiently if providers are to do the greatest good for the greatest number during times of mass disasters (Fryberg, 2002; Hoey & Schwab, 2004; Kilner, 2002). If the goal of healthcare during mass casualty events is increased survivability with minimal disability within a context of restricted resources, then organizational systems within the ICS structure must have the capability to respond in a manner that positively influences these outcomes.

The organizational structure of a mass casualty event is unique in terms of its short and temporary lifecycle, the potential for conflicting beliefs among team members about prioritization criteria for triage decisions, the disparate and unpredictable nature of the workforce, environmental conditions, and patients. The organizational structure in a mass casualty event includes multidisciplinary teams that support triage functions across the continuum of care (Hoey & Schwab, 2004). Such triage functions may include: rescue from a potentially dangerous environment; decontamination if appropriate; ongoing prioritization of the sick and injured based on the severity of their conditions and chance for survival with healthcare intervention; rapid stabilization; and transport to the
appropriate definitive treatment facility (Benson et al., 1996; Ihlenfeld, 2003; Knopp et al., 1988; Landau et al., 1982; Schultz et al., 1996).

The nature of mass casualty events requires an organizational structure that is time limited to hours, days or weeks, is defined by the type of disaster (environmental context), and brings together a wide skill mix of individuals (workforce) who may never have worked together before to create a work structure. The work structure itself is, in turn, influenced by such factors as: 1) organizational customs (the life cycle of the event, leadership style of management and the incentive structure of the organization); 2) triage level organizational complexity (number of workforce specialties, size of the workforce, relationships within the functional unit of the workforce and degree of technology used within the triage unit); 3) patients (individual characteristics); 4) resources (availability, type and location); and 5) the characteristics of information and technology needed to support this entire process. The short time frames required to develop a fully operational organizational structure must be considered (Ferketich & Verran, 1990).

Providing real-time visibility of data that track patients, personnel, resources and potential hazards is a critical component of the information systems needed to provide situational awareness and decision support to authorized users at each point in the triage continuum of care (Chan et al., 2004; Plischke et al., 1999; Simon & Teperman, 2001). However, the 2001 Institute of Medicine (IOM) report describes a health care system that has been relatively untouched by the revolution in information technology and cites disaster care as a special area of concern. Recent events, such as the 2005 Katrina and Rita hurricane disasters, the 2004 tsunami that devastated the shores of Indonesia, Sri
Lanka, South India, and Thailand, and the 2001 attacks on the World Trade Center and Pentagon illustrate the inadequacy of current mass casualty support systems.

Purpose

The purpose of this research was to validate a comprehensive conceptual model for mass casualty events (Fig. 1). A systems approach was used to consider the broad context in which mass casualty events take place. The conceptual model for a mass casualty event (labeled Mass Casualty Conceptual Model or MCCM, for this study) was designed based upon extant literature and existing theoretical models. The model was validated using a panel of experts.

Research Questions

The research questions were directed toward the construction, refinement, evaluation and initial exploration of validity for a conceptual model of mass casualty triage. The specific research questions addressed were:

1. To what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?
2. To what extent do experts agree that the proposed relationships among the constructs presented in the model provide valid representations of mass casualty triage?
3. To what extent do experts agree that the proposed indicators for each construct represent appropriate measurements for the constructs?
4. To what degree is the proposed model evaluated by experts as useful to the further study of information and technology requirements during mass casualty events?
Figure 1. The Mass Casualty Conceptual Model (MCCM)
Significance

There is a paucity of literature evaluating mass casualty systems and no clear ‘gold standard’ against which to measure the performance of a triage system. Most of the research related to the use of information systems employed for triage and the care of mass casualties involves the evaluation of existing or emerging technologies without a clear understanding of the information, systems and decision support needs of providers and public health officials. Currently, the literature does not include an established theoretical framework for evaluating the effectiveness or efficacy of information decision support systems for mass casualty events, and most particularly, for events that include the use of chemical, radiological or biological material.

A theory driven conceptual model for mass casualty events may afford researchers the opportunity to: (a) investigate the interactions between patients/victims, nurses/healthcare professionals, and information technology/nursing systems; and (b) identify and validate practice models, policies, and solutions that incorporate continuity of care within complex mass casualty care systems. Research structured around a continuity of care (as opposed to episodic, one-on-one care) model supported by interdisciplinary teams of healthcare professionals may help to move science forward in the area of emergency preparedness and ultimately maximize survival rates during times of mass casualty incidents (Landau et al., 1982). Research that focuses on an understanding of the interdisciplinary structure, process, outcomes and contextual variables that affect mass casualty triage also can be used to identify and measure the specific contributions of nursing to the triage continuum of care. Specifically, the model
proposes the key relationships among entities/factors in mass casualty events that need to be investigated and offers a more comprehensive view of mass casualty events.

Summary

Chapter I provided an overview of the problem and defined the purpose of the research, as well as the research questions to be answered. In addition, the potential significance of the study was described.
CHAPTER II: THEORETICAL PERSPECTIVE

Introduction

In chapter two the theoretical underpinnings for the proposed Mass Casualty Conceptual Model (MCCM) are discussed, including the conceptual constructs and the basis for assumed relationships among constructs. A synthesis of previous mass casualty research is presented to provide a background and context for the study. Extant literature suggests a number of key constructs that should be included in an information model for mass casualty triage. Based on a review of the literature and the influence of two systems theories and one informatics model, a conceptual model is proposed to describe the information needs for a mass casualty continuum of care. Measurement variables for each construct are also specified.

Synthesis of Previous Mass Casualty Research

Because mass casualty events do not lend themselves to randomized, controlled, experimental trials, current evaluations of mass casualty events are usually anecdotal. In addition, much of the anecdotal data has little external validity because no two disasters are exactly alike so they share few factors in common. Finally, no consensus currently exists on standardized definitions or indicators for specific aspects of disasters (Birnbaum et al., 2006).

The September 11, 2001 attacks on the World Trade Center and Pentagon clearly demonstrated the need to improve emergency preparedness and the healthcare response to mass casualty care (Berkowitz, 2002; Downing, 2002). During the September 11 attacks, communication between on-the-scene coordinators and hospitals was almost
nonexistent (Simon & Teperman, 2001). As a result, many victims were transported to hospitals that lacked both critical facilities and staff; and health care providers and fire fighters had difficulty communicating with one another (Simon & Teperman, 2001).

In 2002, the Russian government used a gaseous agent thought to be Fentanyl to disable terrorists in a Moscow theater. More than 100 of the hostages died. Health care personnel later reported that most deaths were due to lack of vital signs monitoring at the scene and an inability to organize care to determine who was breathing and who was not. This tragedy too highlighted the need of field personnel, the command center and receiving hospitals for accurate, real-time information.

In 1995, there was a Sarin nerve-gas attack in a Tokyo subway. More than 100 emergency responders at the scene were injured; and one-quarter of emergency room hospital staff became symptomatic through cross-contamination from victims - an example of contamination from "hot zones." Information systems need to be designed to provide situational awareness to providers and the command center, so that responders do not accidentally move into hot zones and transport patients to medical facilities without proper decontamination.

Emergencies put huge demands on health and emergency services. Continuity of health services must be maintained while increasing surge capacity (i.e., the ability to handle increased numbers of patients quickly and efficiently). Put differently, the hospitals and other agencies must provide services to their usual patients at the same time that they meet the needs of victims and the “worried well.” This is especially true in cases where resources are limited and victims are isolated from services.
The majority of systems for disaster response and field health care rely on paper triage tags that are attached to the patients and on pen, paper and clipboards to record aggregate information on patients, ambulance availability and hospital status. Radio and face-to-face interactions have been the primary communication methods to deliver information about patient status. Most hospitals depend upon the use of manual business processes to monitor patient demand. More technologically sophisticated facilities may track patients using bar-coded ID bands or monitor bed occupancy as secondary indicators of the demands on the healthcare delivery system and (Fry & Lenert, 2005).

Several studies have reviewed the accuracy of triage decisions using the Emergency Severity Index (Tanabe et al., 2004; Wuerz et al., 2001), as well as other traditional methods and triage tools (Bond et al., 1997; Burkle, 2002; Burstein et al., 1996; Esposito et al., 1995; Fernandez et al., 1999; Henry et al., 1996; Kilberg et al., 1998; Knopp et al., 1988; Lowe et al., 1986; MacKenzie et al., 1999; Vayer et al., 1986). The Centers for Disease Control and Prevention (CDC website), Plischke et al. (1999), Smart Incident Command System (website) and the START Web site summarize the strengths and limitations of triage tools currently in use. Various versions and combinations of these tools are currently in use throughout the country. The lack of standardization in these devices can pose problems when responders from across jurisdictions are mobilized to a mass casualty incident and are required to adjust to an unfamiliar triage tool.

The need for consistent competencies for emergency care providers has resulted in a very diverse emergency provider workforce in terms of educational preparation,
experience, knowledge, skills, credentials/certifications and training (Gebbi et al., 2002; Weckerle et al., 2001). Halpern et al. (2003) discuss the importance of the timely identification of human and material resources that can be efficiently mobilized during mass casualty events. Domres et al. (2001) discuss the ethics of mass casualty triage related to the imbalance between needs and supplies. These studies point out the need for the development of systems capable of identifying resources and tracking their mobilization to afford the greatest chance for survivability during mass casualty incidents.

A Medline search for articles related to the combined categories of triage, mass casualties and informatics yielded only two articles. One study reviewed the START triage system used in a simulated mass casualty event (Risavi et al., 2001); the other study investigated the use of the Internet to control mass casualty chaos (Hamilton, 2003). A further search for methodologies used to evaluate triage capabilities and outcomes included traditional functional drills (Domres et al., 2001) and evaluations of computer decision tools vs. memory-based triage methods (Dong et al., 2005, Jones et al., 1997). However, none of these triage systems or tools has yet been tested under disaster conditions involving hundreds or thousands of multiple casualties (Ihlenfeld, 2003). It is worth pointing out that the triage of children has been shown to require different strategies and methods (Engum et al., 2000). Significantly, none of the studies reviewed included a theoretical or conceptual model.
Theoretical Underpinnings of the MCCM

The proposed MCCM (Fig. 1) is a multi-level model that uses an open systems, non-reductionist approach to study the effects of context on the functioning and information needs of multidisciplinary teams during mass casualty triage. The MCCM was derived from two systems theories (Structural Contingency Theory, and Technology Theory) and one informatics model (Vicente’s {2004} Human-Tech Ladder Model). Figure 2 depicts the influences of the theories/models on each stage and construct of the proposed model.

Structural Contingency Theory (SCT) views context as both external (outside the boundaries of the focal unit of interest) and internal (within the focal unit of interest). Technology Theory emphasizes internal (i.e., within the focal unit of interest) context. The focal units of interest for this research are Information Technology, Structure and Triage. The levels of data collection included in the conceptual model are at the Emergency Operation Center and Triage Unit levels.

The MCCM has been defined at five stages (Fig. 1). Stage I (External Contextual Environment) describes six constructs of the external context for a mass casualty event that influence the internal context (Information Environment and Structural Environment). Stage I constructs represent the influences of Organizational Customs, Triage Unit Organizational Complexity, Environmental Context, Patients, Resources and the Workforce. Data measuring these constructs are at the Emergency Operation Center and Triage Levels for data collection and analysis (Fig. 3-5).
Figure 2. Influence of the Three Theories/Models on the MCCM
Figure 3. MCCM Stage I: Contextual Environment - Organizational Customs and Triage Unit Organizational Complexity
**Triage Level**

![Diagram of Triage Level]

Figure 4. MCCM Stage I: Contextual Environment - Environmental Context
TRIAGE LEVEL

PATIENTS
- Injury (#, Type)
- Demographics
- Variability (Exceptional Cases)

WORKFORCE
- Credentials/Licenses
- Experience
- Experience with Technology
- Training
- Skill Mix
- Education
- Safety and Health Needs
- Age

RESOURCES
- Categories
- Amount
- Location

Figure 5. MCCM Stage I: Contextual Environment - Patients, Resources and Workforce
Stages II (Information Environment), III (Structural Environment), and IV (Triage) together define the internal context for a mass casualty event. It is within this context that data are collected and analyzed at the Triage Level. Stage II (Information Environment) includes the construct of Information Technology, which is influenced by both technology and information (Fig. 6). The characteristics of these factors directly influence Structure (Fig. 7) and Structure in turn influences Information Technology. This relationship is illustrated by the bidirectional arrows in Figure 1.

Stage III (Structural Environment) describes the organizational framework needed by each triage unit (from hierarchical to flexible) to support the needs of the workforce in managing the diverse needs of each patient. The degree to which a hierarchical or flexible structure is appropriate is influenced by the knowledge and technology available at the point of care to control patient variance at the source (Fig. 7). Data at this stage are collected and analyzed at the Triage Level or point of care.

Stage IV (Triage) describes the process used to classify and prioritize victims according to predetermined severity algorithms to ensure the greatest survivability within a context of limited resources. Accurate triage depends on an appropriate organizational structures and information technology that facilitates the communication of information in a manner that assists the workforce to classify and prioritize the treatment of patients with the optimal use of resources (Fig. 8). Data at this stage are collected and analyzed at the Triage Level.
Figure 6. MCCM Stage II: Information Environment
**TRIAGE LEVEL**

![Diagram of TRIAGE LEVEL]

Figure 7. MCCM Stage III: Structural Environment

**TRIAGE LEVEL**

![Diagram of TRIAGE LEVEL]

Figure 8. MCCM Stage IV: Triage
Stage V (Goals) defines outcomes for both patients and resources; and data at this stage are collected and analyzed at the Triage Level. The numbers of lives saved and deformities prevented by the appropriate use of resources are a measure of the efficiency and appropriateness of the structure and processes of the organizational system including nursing (Fig. 9).

Stages II, III and IV represent the focal unit (i.e., the internal context) for the study. Stages I and V occur outside the boundaries of the focal unit for this study. The next section of this chapter discusses the influences of each of the systems theories and informatics model on the development of the MCCM.

Influences of Environmental Systems Theories on the Model

**Structural Contingency Theory**

The major constructs/concepts in Structural Contingency Theory (Burns & Stalker, 1961; Lawrence & Lorsch, 1967) measure the fit between structure and contingency factors within and outside of the organization. Contingency factors are labeled as contextual constructs in this study. Relational statements that link these constructs/concepts describe the ‘fit’ between structure (Internal Environment) and context (both Internal and External Environment) to outcomes. It is the ability of an organization to adjust to contextual influences through hierarchical or flexible structures that impact outcomes. Key concepts/constructs include the following contingency or contextual factors:

- Context – the primary contingency factor and driving force. Context is defined as:
Figure 9. MCCM Stage V: Goals
− Elements that exist outside the boundary of the organization and have the potential to affect all or part of the organization.
− Elements within the organization that interact with the larger organization.

Elements within the subunits (Internal Environment) include:

- Contextual elements external to the organization (External Environment) that reflect the influence of the environment in which the organization is located include:
  - Environmental contextual factors such as the duration, setting, size and nature of the environment or mass causalities that affect differentiation and integration of the organization. These factors may require that parts of an organization face more uncertainty relative to other parts.

- Structure – a concept that describes the type of organizational framework needed by each triage unit (from hierarchical to flexible) to support the needs of the workforce in managing the diverse needs of each patient. Structure is influenced by the following contextual elements: Organizational Customs, Triage Unit Complexity, Environmental Context, Patients, Resources, Workforce and Information Technology. These contingency or contextual concepts determine the degree of uncertainty that must be managed to affect outcomes of care. Uncertainty relates to the stability or the dynamic nature of the environment and therefore influences the type of structure needed for each triage unit of care. Low uncertainty tasks are most effectively performed by hierarchical organizations. As
task uncertainty increases the more complex and differentiated the structure and the increased need for participative or flexible structures.

- Technology - high levels of technology require a flexible structure with loosely defined roles of participation.

Technology Theory

Technology theory (TT) defines technology as the means, activities and knowledge used to transform materials and inputs into organizational outputs (Jaffee, 2001). The original research on TT was conducted by Woodward in the late 1950’s and involved core technology that looked at the types of technology and organizational characteristics. TT considers the use of human brain power that uses ‘open processes’ to manage rather than reduce complexity. The greater the use of open processes, the greater will be the shift from hierarchical formal structures that limit worker discretion to those that emphasize innovation and creative problem solving. This theory usually considers only the internal environment. TT dominated organizational theory in the 1960’s and preceded the enormous growth in information technologies.

TT influences this model through the identification of contextual variables that seek to define the variability or routineness of the patients. Variability in patients, or exceptional cases as defined by Perrow (1967), determines the search behaviors needed by the work force. Search behaviors relate to a rich skill mix workforce with the ability and information to use judgments, experience and or intuition to influence outcomes by controlling variability at the source. Task uncertainty that is reflective of patient variability and other contextual environmental factors influences the acquisition and
processing of data transformation into information and knowledge. The capability of the workforce to use this information and knowledge to support search behaviors determines the fit of the structure or work design of each triage unit. It is assumed that the greater the variability and task uncertainty, the greater the need for a more flexible structure.

The relational statements that link the constructs/concepts in TT describe the effects of patients on the nature of the work and technology. Technology determines the fit of the structure to organizational needs of each triage unit. In other words, task-related technologies involving low variability and high analyzability are suited to a hierarchical structure. On the other hand task-related technologies involving high variability and low analyzability are more suited to a flexible structure. Key constructs/concepts include:

- **Technology** – the primary contingency or contextual factor. The type of technology that is used to act on the organization’s patients determines the fit of the structure. The nature of the technology includes:
  - The sequencing of activities in the workflow;
  - The rate of flow of activities; and
  - The characteristics of the technology that include: ergonomics, functionality, and amount of technology employed.

- **Patients** – considered the material that needs to be transformed into a desired result. Characteristics of the patients include:
  - Understandability – perception of the organization on the nature of the patients to achieve predictability that includes the nature and types of injuries; and
Variability – whether patients can be treated in a standardized fashion without continual adjustment.

- Structure – that relates to task uncertainty or the nature of the work to be done that is characterized by the degree of routineness determined by:
  - Exceptional cases – variability in the patients. The number of exceptional cases determine the levels of analyzability or predictability;
  - Search behavior (analyzability) – degree to which judgment, experience or intuition must be used to assess and treat patients when exceptions occur. The more exceptions in the workflow the greater the search behaviors. When the search process is difficult, work is technologically complex; and
  - Structure – or the degree of hierarchical to flexible structure needed to control variance at its source.

The MCCM is based on a theoretical approach that seeks to describe the relationship between the external and internal contingency or contextual constructs on patient and resource outcomes. Figures 3-9 more clearly depict the contributions of the two theories to the MCCM. Each figure represents one of the five stages of the model and specifies the constructs and proposed indicators for each of the constructs. The influence of these two models on the MCCM is summarized in Table 1 and 2.

Influences of Informatics Models

*Human Factors Influences*

For computer systems to be useful they must be considered effective and efficient by the end user(s). Human factors is used to study the interaction between people,
Table 1. Influences of Structural Contingency Theory on the MCCM

<table>
<thead>
<tr>
<th>STRUCTURAL CONTINGENCY THEORY CONCEPTS</th>
<th>MCCM CONSTRUCT AND INDICATORS</th>
</tr>
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<tbody>
<tr>
<td>‘Fit between structure and internal and external contingency factors’</td>
<td></td>
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<tr>
<td><strong>External Contingency Factors</strong></td>
<td>Environmental Context</td>
</tr>
<tr>
<td>• Elements that exist outside of the boundary of the organization and have the potential to affect all or part of the organization</td>
<td>– Nature</td>
</tr>
<tr>
<td>• The primary contingency factor is context</td>
<td>– Geographic size</td>
</tr>
<tr>
<td>• These factors affect differentiation and integration of the organization and may require that parts of an organization face more uncertainty relative to other parts</td>
<td>– Duration</td>
</tr>
<tr>
<td>• Environmental Context</td>
<td>– Warning systems</td>
</tr>
<tr>
<td>• Geographic size</td>
<td>– Setting</td>
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<tr>
<td>• Duration</td>
<td></td>
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<tr>
<td>• Warning systems</td>
<td></td>
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<tr>
<td>• Setting</td>
<td></td>
</tr>
<tr>
<td><strong>Internal Contingency Factors</strong></td>
<td>Structure - within each triage unit (from hierarchical to flexible) needed to support the needs of the workforce in managing the diverse needs of each patient</td>
</tr>
<tr>
<td>• Elements that exist and interact within the organization</td>
<td></td>
</tr>
<tr>
<td>• Structure describes the type of organizational framework needed to achieve desired outcomes</td>
<td>External contingency or contextual factors that influence structure:</td>
</tr>
<tr>
<td>• Structure is influenced by external contingency or contextual factors</td>
<td>• Organizational Customs</td>
</tr>
<tr>
<td>• These contingency or contextual concepts determine the degree of uncertainty that must be managed to affect outcomes</td>
<td>• Triage Unit Complexity</td>
</tr>
<tr>
<td>• Uncertainty relates to the stability or the dynamic nature of the environment and therefore influences the type of structure needed</td>
<td>• Environmental Context</td>
</tr>
<tr>
<td>• Low uncertainty tasks are most effectively performed by hierarchical organizations</td>
<td>• Patients</td>
</tr>
<tr>
<td>• As task uncertainty increases the more complex and differentiated the structure and the increased need for participative or flexible structures</td>
<td>• Resources</td>
</tr>
<tr>
<td>• High levels of technology require a flexible structure with loosely defined roles of participation</td>
<td>• Workforce</td>
</tr>
<tr>
<td></td>
<td>• Information Technology</td>
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### Table 2. Influences of Technology Theory on the MCCM

<table>
<thead>
<tr>
<th>TECHNOLOGY THEORY CONCEPTS</th>
<th>MCCM CONSTRUCT AND INDICATORS</th>
</tr>
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<tbody>
<tr>
<td>‘Means, activities and knowledge used to transform materials and inputs into organizational outputs’</td>
<td></td>
</tr>
<tr>
<td>• The identification of contextual variables that seek to define variability or routineness</td>
<td>• Patients – material that needs to be transformed into a desired result</td>
</tr>
<tr>
<td>• Variability or exceptional cases determines the search behaviors needed to control variance at its source</td>
<td>• Patient indicators include:</td>
</tr>
<tr>
<td>• Task uncertainty influences the acquisition and processing of data transformation into information and knowledge</td>
<td>– Understandability – perception of the organization on the nature of the patients to achieve predictability including nature/types of injuries</td>
</tr>
<tr>
<td>• Technology determines the fit of the structure to organizational needs</td>
<td>– Variability – whether patients can be treated in a standardized fashion without continual adjustment</td>
</tr>
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</tr>
<tr>
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<td>– Characteristics of technology such as ergonomics, functionality and amount</td>
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<td></td>
<td>– Work flow</td>
</tr>
<tr>
<td>• The type of technology that is used determines the fit of the structure</td>
<td>– Rate of flow</td>
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<td>• Structure – relates to task uncertainty or the nature of the work to be done characterized by the degree of routineness Structure indicators include:</td>
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<td>• Patient indicators include:</td>
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<td>– Exceptional cases – variability in the patients</td>
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machines, and their work environment. System usability (Aarts & Berg, 2004; Ash et al., 2004) is a major threat to the success of an information system. A majority of information systems are never fully implemented due to omissions in recognizing and fully appreciating the complexity of usability issues. Kaplan and Shaw (2004) identify common threads that run through evaluation research related to system design, development, implementation and use. They conclude that a multi-level approach throughout the life cycle of a project is necessary to understand human and organizational concerns.

Vicente’s (2004) model can be used to understand the fit of technology to humans. Vicente’s model begins by identifying the human or societal need related to a specific technology and then organizes knowledge of people into five levels: physical, psychological, team, organizational, and political. The model puts people first and technology second. Identification of human or societal needs provides the foundation for technology tailored to the human factors that govern behavior. Vicente points out the importance of understanding and evaluating each level of the model as it applies to an organization. For example, it is possible for each team in the triage model to be doing an excellent job of coordinating internal activities and for each individual within the team to be doing an outstanding job of performing the mental and physical tasks to which they are assigned, but the organization as a whole can be floundering if the various teams pursue conflicting objectives?

Vicente applied his framework to several healthcare problems. In one study he found that 82 percent of anesthesia adverse incidents were attributed to human error
(Vicente, 2004, p. 142-153). In another study system design errors that required as many as twenty-seven programming steps contributed to the misprogramming of patient controlled analgesia infusion pumps resulting in the over dosing and estimated deaths of between 65 and 667 patients (Vicente et al., 2003).

Vicente’s model is integrated within the MCCM to identify variables and relationships that must be built into a system to achieve a good fit. Appendix A illustrates the key components of the model and their application within the MCCM. The MCCM excludes political level relationships at the local, state and federal levels that include policies, regulations and budgets. Although political level functions are important to mass casualty events they are beyond the scope of analysis of this research. The constructs of the MCCM include indicators to measure the various components of the Vicente Model.

Conclusion

This chapter described the model and its theoretical underpinnings. The proposed MCCM was derived from empirical observations, insights and deductions, existing literature and theoretical/conceptual models. The conceptual model is highly abstract, contextually driven and multi-level with dynamic interactions or relationships that are temporally ordered based upon three theoretical perspectives.
CHAPTER III: METHODOLOGY

A modified Delphi process was used to establish consensus of a panel of experts for the validity of a proposed comprehensive conceptual model for mass casualty events. This chapter discusses the Delphi process used, including definitions, sample, design, instrumentation, the data analysis plan, human subjects protection, and study limitations.

Delphi Process

The Delphi process was developed as a procedure for obtaining expert consensus on a particular topic (Rowe et al., 1991). The Delphi method was developed in the 1950’s at the Rand Corporation to forecast the impact of technology on warfare (Dalkey & Helmer, 1963). This technique differs from other group data collection processes through: 1) anonymity, 2) interaction with controlled feedback, 3) statistical group response; and 4) expert input (Goodman, 1987; Snyder-Halpern et al., 2000). Since the original work on the Delphi method, multiple versions have been developed and used in research and industry (Crisp et al., 1997).

Delphi processes have been applied extensively in healthcare (Akins, 2005; deMeyrick, 2003; Goodman, 1987; Jones & Hunter, 1995; Linestone & Turoff, 2002). Delphi techniques have also been used to develop models (Linestone & Turoff, 2002). The Delphi process is most suitable when:

- The problem does not lend to precise analytical techniques and could benefit from subjective judgments based on collective wisdom;
- The individuals needed to contribute to the examination of a complex problem represent diverse backgrounds;
Participants are dispersed over a wide geographical area so that time and costs preclude face-to-face meetings;

Heterogeneity of participants must be preserved to assure validity of results (Scheele, 2002).

The Delphi process typically involves the recruitment of a panel of experts on a specific topic. Each expert independently responds to a question(s) designed to elicit opinions, estimates, or predictions regarding the topic. Responses are then aggregated, tabulated, summarized and returned to the experts in a series of data collection rounds. This iterative process is repeated until a consensus of opinions, predictions, or beliefs is reached (Snyder-Halpern et al., 2000). Qualitative input is also solicited by requesting experts whose score on any question is significantly far from the group mean to explain the reasons for their positions (Brockhoff, 2002).

**Consensus**

Consensus, or agreement, refers to the extent to which each respondent agrees with an issue that may be rated on a numerical or categorical scale, and the extent to which experts agree with one another that may be assessed statistically through average and dispersion (Jones & Hunter, 1995). Establishing consensus provides a way to identify the central tendency of data that cannot be evaluated using statistical methods (Jones & Hunter, 1995). Delphi techniques permit the reporting of the entire group response together with measures of central tendency and dispersion (Verran, 1981). Definitions of consensus within Delphi studies range from true consensus to majority rule (Williams & Webb, 1994).
There is no underlying statistical theory that defines an appropriate stopping point in a Delphi process (Scheibe et al., 2002). There is always a certain amount of oscillatory movement and change within the group; but respondents are sensitive to feedback of the scores from the whole group and tend to move toward the perceived consensus, or centralize. In the majority of Delphis, consensus is assumed to have been achieved when a certain percentage of the opinions fall within a prescribed range or when the inter-quartile range is no larger than two units on a ten-unit scale (Linestone & Turoff, 2002). However, this method may not take into account all of the information in the distributions. For example, a bimodal distribution may occur or a distribution may flatten out which may not be registered as a consensus but indicate important areas of opinion. In a review of 126 papers, deMeyrick (2003) found that 33 different statistical measures of convergence or consensus were applied. The most common measures were mean or median, ratings or rankings, standard deviations, inter-quartile ranges, percentage ratings and Chi square (for categorical data) or ANOVA (for continuous data). Other researchers applied arbitrary decision rules to determine when consensus is established, such as the attainment of a certain level of agreement or completion of a stipulated number of iteration (deMeryick, 2003).

Measuring the stability of the panel of experts’ opinion distribution curve over successive rounds may be preferred to methods that measure the amount of change in each individual’s opinion between rounds or the degree of convergence because it considers variations from the norm (Scheibe et al., 2002). A reasonable cut-off or
stopping point is determined when responses are unchanged and stable. A 15% or less change level indicates stability (Scheibe et al., 2002).

In most Delphi studies, the final-round inter-quartile range is smaller than the initial range; and convergence is more common than divergence over a number of rounds. A point of diminishing returns is usually reached after a few rounds and that three rounds often provides sufficient interactions to attain stability in the responses (Linestone & Turoff, 2002).

Feedback

The type of feedback provided to the panel of experts varies. Feedback may include statistical summaries that provide measures of central tendency such as variance, mean, median and mode, as well as comments provided by individuals (Alderson et al., 1992; Crisp et al., 1997). Ranking, percentages and inter-quartile ranges are also commonly used to provide feedback (Jones & Hunter, 1995). Agreement is usually summarized by using the median and consensus reported by using inter-quartile ranges for continuous numerical scales. Histograms and other graphical representations of statistical summaries may also be included to provide a clearer visualization of the responses. Subjective rationales from the panel of experts who score questions significantly distant from the group mean value scores may be summarized and provided as anonymous feedback during the next round (Jones & Hunter, 1995; Custer et al., 1999). It is important to determine the nature and strength of the feedback influence (Schiebe et al., 2002).
Expert Panel

The expert panel is one of the most fundamental components of a Delphi study. The strength of Delphi is the belief that ‘n +1’ participants are better than one (Crisp et al., 1997; Verran, 1981). Traditionally there is little agreement about sample size and no criteria exist against which sample size can be judged; therefore, studies have been conducted with virtually any size panel (Atkins, 2005). The sample size in most Delphi studies has been researcher and situation specific, with the use of convenience samples dependent on availability of experts and resources (Akins, 2005). Using a convenience sample allows researchers to purposefully select experts that can apply their knowledge and experience to the specific issue or problem under investigation (Atkins, 2005; Snyder-Halpern et al., 2000). If experts are selected who have similar training and general understanding of the problem of interest, a relatively small sample can be used (Atkins, 2005). This is particularly useful when there are only a limited number of experts in a field of interest. Linestone and Turoff (2002) suggest the following mix of experts:

- Stakeholders or those who are or will be directly affected;
- Those who have an applicable specialty or relevant experience;
- Those who have skills in organizing, synthesizing and stimulating; and
- Interdisciplinary members.

Self-rating is a meaningful basis for identification of expertise (Linestone & Turnoff, 2002). Linestone and Turnoff (2002) suggest the use of a 5-point scale, where low numbers represent low degree of expertise and high numbers are used to represent a
high degree of expertise. The expertise of a group can be characterized by the median of individual self-ratings.

*Anonymity*

Anonymity is considered an important component of most Delphis. The objective of anonymity is to remove some of the common biases normally occurring in the face-to-face group process. Anonymity provides the opportunity for a panel of experts to be freer to share opinions or to move their opinion without the pressure of conforming to group opinion. Anonymity can also have negative effects on the process. After repeated rounds, experts may no longer feel committed to the issues and change their responses to bring a more expeditious end to the process (deMeyrick, 2003).

Turoff and Hiltz (1995) note that two primary factors in motivating participation in a Delphi are (a) the belief that the members are communicating with a peer group and (b) the belief that members will obtain value from the information they receive as a result of the process. It is important that Delphi members feel that other members of the group will also be able to contribute valuable insights into the problem being studied.

*Computer Applications*

The Delphi process is usually associated with mailed paper and pencil questionnaires, but face-to-face interactions have also been used. Computer mediated communication can support the Delphi technique in ways that may be superior to other forms of communication when any of the following conditions are met:

- Individuals are busy and frequent meetings are difficult;
- The group is spread out geographically;
• Topics are complex and require reflection; or
• Written records are desirable (Linestone & Turoff, 2002).

Computer mediated communication systems can be used to carry out a Delphi process. Communications may be either synchronous or asynchronous. A computer-mediated Delphi is helpful for dealing with situations of unusual complexity such as the building a model because experts can see the results and consequences of the current design (Turoff & Hiltz, 1995). Using the Internet for implementing a Delphi technique offers “distinct advantages over the traditional mailed approach in terms of time and costs” (Snyder-Halpern et al., 2000, p. 812). The communications used to structure group interactions can produce results that are of better quality than any single individual in the group could achieve acting alone (Hiltz & Turoff, 1978).

Computer-mediated Delphis enable experts to communicate with each other even though they may be separated by long distances. Computer-mediated Delphis facilitate the computation of quartiles, as well as the preparation, distribution, collection, revision and distribution of questionnaires that can reduce the turn-around time between rounds (Linestone & Turoff, 2002).

Modified Delphi Process

The traditional Delphi process usually begins with an open-ended questionnaire followed by three to four rounds of feedback and modified questionnaires (Custer et al., 1999; Snyder-Halpern et al., 2000). A modified technique has been employed in many studies to improve initial-round response rate (Custer et al., 1999; Snyder-Halpern, 2001). The modified technique begins with pre-selected items drawn from various
sources including synthesized reviews of the literature to provide a context for responses (deMyrick, 2003; Snyder-Halpern et al., 2000). The number of rounds may be decreased to as few as two if experts are provided with the list of pre-selected items and if early consensus is reached (Martino, 1983; Snyder-Halpern, 2001; Snyder-Halpern et al., 2000).

One problem that is often encountered in Delphi studies is maintaining participants’ focus if questionnaires have large numbers of items (Custer et al., 1999). Delphi studies may contain 50 or more items for consideration. Modifications that involve the presentation of pre-selected items and purposeful sampling can reduce panel attrition and burnout.

Research Design and Methods

The modified technique was used to present a proposed conceptual model for mass casualty triage to a panel of experts. The panel of experts was asked to describe the extent to which they agreed that:

1) The constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events;

2) The proposed relationships among the constructs presented in the model provide valid representations of mass casualty triage;

3) The indicators for each construct represent appropriate measurements for the constructs; and

4) The proposed model is seen by experts as useful to the further study of information and technology requirements during mass casualty events.
Sample

A purposeful sample of 18 panel members was recruited from local, regional and federal levels of emergency preparedness or response organizations and/or institutions that conduct research related to emergency preparedness. Selecting a multidisciplinary panel of providers, emergency planners/responders and emergency preparedness researchers helped to ensure that the panel included stakeholders, as well as individuals with relevant experience in emergency planning, response and emergency preparedness research.

Panel eligibility included: 1) a position title that reflects direct involvement in local, regional/county, state, federal, or military emergency preparedness, response or research in the area of emergency preparedness; 2) multiple provider and emergency planning, response and/or research positions; 3) representation at the local, regional and federal levels of emergency response and preparedness; 4) self-rating of expertise of three or greater on a 5-point Likert scale where low numbers represent a low degree of expertise and high numbers are used to represent a high degree of expertise; 5) availability of a computer system that includes Internet access with sound capability and email access; and 6) willingness to participate in the study given the time frames indicated in the request to participate email.

Individuals known to the researcher who met eligibility criteria were contacted by email and invited to participate or to recommend an individual that met the eligibility requirements (a snowballing technique). Twenty-six individuals were initially contacted (Appendix B). A Disclaimer Form explaining the purpose of the research (Appendix C)
was then emailed to the 21 individuals who expressed interest in participating. Once the disclaimer form was returned (via email), indicating an interest to participate, individuals were asked, in an email message, to complete an online Panel Profile Survey (Appendix D) through SurveyMonkey (www.surveymonkey.com), an online custom survey software tool. The survey was designed to capture demographic and eligibility criteria information and included a self-rating scale of expertise in the areas of emergency planning, response, and/or research. Demographic information was important to the selection process and to future communication with each participant.

Responses to the Panel Profile Survey were used to select the panel of experts based on criteria previously discussed. Two potential panel members were unable to access SurveyMonkey due to server configuration restrictions established by their employer, so they were eliminated from the study. Eighteen expert panel members completed the survey and were selected to participate in the study.

After several panel members requested information about the composition of the panel, a Revised Disclaimer Form (Appendix E) was emailed to all 18 panel members that included the option to request a list of panel members participating in the study (see the “Human Subjects Protection” section of this chapter for further information). All 18 individuals returned the Revised Disclaimer Form.

Once the panel was selected, each member received an email (Appendix F) directing them to the web page designed for this research (www.u.arizona.edu/~jculley). See Appendix G for a screen image of the web page. Panel members were given one week to review the content on the web page. One panel member was not able to
adequately access the narrated presentations, so all files from the web page were copied to a CD and overnight mailed to that panel member.

Communication Technology

Computer, Internet and email applications were used to support the modified Delphi process. SurveyMonkey was used to create and present the Panel Profile Survey and each round of questions in the Delphi process, as well as to collect responses. Each panel member was identified only by a unique number assigned by SurveyMonkey. SurveyMonkey allowed customized email invitations to be sent to each panel member with an imbedded link to a specific questionnaire.

A web page (Appendix G) specifically designed for this study could be accessed by all panel members through the University of Arizona Center for Computing and Information Technology (CCIT) at www.u.arizona.edu/~jculley. The web page was used to facilitate communication with the panel of experts. The web page provided access to:

- An online narrated PowerPoint presentation that provided specific information regarding the Delphi process including a description of the process to be used and directions on how to navigate the web page (Appendix H).

- An online narrated PowerPoint presentation explaining the model (Appendix I). This was available throughout the study as a reference for all panel members. The online presentation provided:
  - An overview of the model and the theoretical underpinnings of the model;
  - Information about each construct in the model;
  - Information about the relationships among the constructs;
Information about the proposed indicators for each construct.

- A computer graphic file that displayed the original proposed model with all proposed indicators that could be used a baseline reference by all panel members.
- A Glossary of Terms (Appendix J) related to the model.
- The University of Arizona Tucson’s Human Subjects Website.
- Feedback from each round so that comprehensive and up-to-date information was always available to assist with decisions in subsequent rounds.

Procedure

All members of the expert panel were sent customized emails through SurveyMonkey when a round of questionnaires was available. The emails included a hyperlink to the questionnaires. Panel members had the option of leaving the survey and then resuming it later if necessary.

Experts were asked to respond to questions using a 7-point Likert scale, where 1 equals not important and 7 equals critically important to mass casualty triage and, to evaluate the proposed constructs in the model and the relationships between each construct. Experts were also asked to identify and define any additional construct(s) or change(s) in relationship links they believed were needed to adequately assess the continuum care during mass casualty triage (see Appendix K for a copy of the Round One Questionnaire).

Experts were then asked whether each indicator for constructs should be retained, modified or deleted and, if applicable, how they would modify the indicator. Experts
were also asked to identify and define additional indicators needed to adequately measure the continuum of care during a mass casualty triage.

Experts were originally given one week to respond to the on-line questionnaires. The time frame was extended an extra week to allow enough time for the majority of panel members to respond to the questionnaires. The questionnaires were then closed to further on-line activity. Panel members that did not respond to the questionnaire within five days of the posting were sent an email reminding them that they only had one week remaining to complete the questionnaire.

Data from each round were analyzed. The results were presented to the expert panel within five days after the close of each Delphi round. Feedback provided about aggregated data included central tendency, dispersion, and summaries of comments.

The model was modified based on expert consensus about constructs, relationships, or indicators. The revised model and responses from the previous questionnaire formed the basis for the second round of questions. The process continued until the a priori criteria had been met for consensus and/or stability. During the second round of questions, experts were also asked to indicate the usefulness of the model using a 7-point Likert scale, where 1-represented not useful to the further study of information and technology requirements during mass casualty events and 7 represented very useful to the further study of information and technology requirements during mass casualty events. Experts were also asked to answer eight questions evaluating the computerized Delphi process used for the research (see Appendix L Round Two Questions).
**Data Management**

Raw data were downloaded from SurveyMonkey and imported into an Excel spreadsheet. Excel was used to calculate medians, means, quartile ranges, percent agreement, and stability as well as to calculate descriptive statistics related to panel profile characteristics. Tracking of individual results was helpful in analyzing results (Scheibe et al., 2002) although results were reported only in aggregate form.

**Data Analysis**

Expert consensus on each question was used to answer the following research questions:

- To what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?
- To what extent do experts agree that the proposed relationships among the constructs presented in the model provide valid representations of mass casualty triage?
- To what degree is the proposed model evaluated by experts as useful to the further study of information and technology requirements during mass casualty events?

The criteria for consensus were satisfied when the inter-quartile range in scores was of no more than one scale point (Verran, 1981). Stability was calculated for items that did not reach the criteria for consensus to indicate a stopping point for the process. Stability was satisfied when the change in the distribution of responses was less than 15% from one round to the next (Scheibe et al., 2002). The mean of the responses for each question was used to calculate the change in distribution from one round to the next.
Consensus for questions assessing retention, modification, or deletion of each of the proposed indicators for the constructs was determined by calculating the percent of agreement among the expert panel to evaluate the following research question:

- To what extent do experts agree that the proposed indicators for each construct represent appropriate measurements for the constructs?

An inter-rater agreement level of 70% or greater (Snyder-Halpern, 2001) was required to reach consensus to retain, modify, or delete an indicator. Stability was also calculated for items that did not reach the condition of consensus. The condition of stability was met when the change in the distribution of responses was less than 15% from one round to the next (Scheibe et al., 2002). The mean of the responses for each question was used to calculate the change in distribution from one round to the next.

**Human Subjects Protection**

The research project was reviewed and approved by the University of Arizona’s Human Subjects Committee. Several panel members expressed interest in knowing the composition of the expert panel. A request for an amendment to the original Institutional Review Board (IRB) approval was sent to the Human Subjects Protection Program at the University of Arizona requesting permission to re-consent the selected panel of experts with the understanding that the anonymity of the panel of experts from other panel members would no longer be a requirement of the study. All other aspects of the original disclaimer form were maintained. All 18 members were sent, via email, the revised Disclaimer Form (Appendix E) indicating that a list of panel member names participating in this study would be available upon request but their anonymity would be protected.
during all other phases of the Delphi process. Responses on each questionnaire were aggregated so that individual identities remained anonymous. All 18 panel members returned the revised disclaimer form.

Demographic data and responses to survey questions were recorded by ID number only. Individuals recommend by other potential panel members for consideration in the study were told that they had been identified as an expert in the field of emergency preparedness. The name of the recommender was not divulged. All computer files are password protected and only accessible to the researcher. The hard copy of panel members’ names, ID numbers, contact and demographic information will be shredded at the completion of the study.

All files were backed up on an external hard drive utilizing AES 128-bit encryption, password protected and only available to the researcher. SurveyMonkey provides high level security for all data in their possession. Further information regarding the specifics of their security can be found in Appendix M.

Limitations

Linstone and Turoff (2002) warn that opinions that survive a Delphi process may not be the ‘best’ judgments, but rather the compromise position. However, this usually occurs after three or more rounds of the Delphi process. The use of stability measures helps to mitigate the effect of extreme or conflicting positions. The use of the Delphi methodology and the small purposeful sample size limit the ability to generalize findings to all hazards events. The methodology does provide the ability to illuminate behaviors
that are difficult to study using traditional quantitative methods. The effect of computer-mediated communication has yet to be determined on a study of this nature.

Summary

Chapter III provided an overview of the Delphi process, as well as a description of the methods used in this research. A modified Delphi process was utilized to validate the proposed conceptual model for mass casualty events.
CHAPTER IV: RESULTS

Introduction

This chapter summarizes the data analysis for the Delphi process used to validate the proposed conceptual model based on expert consensus about constructs, relationships, or indicators. The results of expert evaluation of the potential usefulness of the model and the computerized Delphi process are also presented.

Sample Characteristics

Tables 3-6 provide a summary of the demographic information related to the 18 member panel. The sample met all of the selection criteria. The sample included an equal number of males (9) and females (9). As shown in Table 3, the mean years employed in emergency preparedness (12.5) and mean rating of expertise (4.0) were higher for males than females. The reported educational level (Table 4) was similar for males and females. All seven areas of responsibility were represented (Table 5); however, 56% represented local geographic areas and 44% represented the research area. Generally males reported holding more credentials than females. The majority of the panel (72%) represented the Northeast geographical area (Table 6), with no representation from the Southwest geographical area.

Position titles of the expert panel were very diverse and represented local, federal and national constituents. Position titles included:

- Director of environmental health and safety
- Director of a large Medical Reserve Corps;
- Director of a metropolitan emergency management system;
- Disaster Medical Assistance Team (DMAT) member;
- EMTs or Paramedics working in the field of emergency response;
- Faculty member teaching in the area of emergency preparedness; and
- GIS emergency preparedness/response coordinator;
- Military who served in emergency preparedness positions;
- Researcher in emergency preparedness;
- Red Cross member.

Table 3. Demographic Characteristics Related to Gender, Age, Expertise and Years Employed in Emergency Preparedness

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean (standard deviation)</th>
<th>Age (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Years Employed Emergency Preparedness</td>
<td>*Rating of Expertise</td>
</tr>
<tr>
<td>Male</td>
<td>n = 9 (50%)</td>
<td>15.2 (12.0)</td>
</tr>
<tr>
<td>Female</td>
<td>n = 9 (50%)</td>
<td>9 (8.4)</td>
</tr>
<tr>
<td>Total</td>
<td>n = 18 (100%)</td>
<td>12.5 (10.8)</td>
</tr>
</tbody>
</table>

*Rating on a scale of: 1 = Very Low Level of Expertise to 5= Very High Level of Expertise

Table 4. Demographic Characteristics Related to Gender and Highest Degree Earned

<table>
<thead>
<tr>
<th>Gender</th>
<th>Associate Diploma</th>
<th>Bachelors BSN</th>
<th>Masters MS MPH</th>
<th>Doctoral PhD</th>
<th>PhD</th>
<th>DNSc</th>
<th>DrPH</th>
<th>MD</th>
<th>MD/PhD</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1 (11)</td>
<td>0 (0)</td>
<td>4 (44)</td>
<td>1 (11)</td>
<td>1 (11)</td>
<td>1 (11)</td>
<td>1 (11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1 (13)</td>
<td>1 (13)</td>
<td>4 (50)</td>
<td>3 (38)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2 (11)</td>
<td>1 (6)</td>
<td>8 (44)</td>
<td>4 (22)</td>
<td>1 (6)</td>
<td>1 (6)</td>
<td>1 (6)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5. Demographic Characteristics Related to Gender and Area of Responsibility

<table>
<thead>
<tr>
<th>Gender</th>
<th>Area of Responsibility* (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Local</td>
</tr>
<tr>
<td>Male</td>
<td>6 (60)</td>
</tr>
<tr>
<td>Female</td>
<td>4 (40)</td>
</tr>
<tr>
<td>Total</td>
<td>10 (56)</td>
</tr>
</tbody>
</table>

*Expert Panel checked all that applied

Table 6. Demographic Characteristics Related to Gender and Geographic Zone

<table>
<thead>
<tr>
<th>Gender</th>
<th>Geographic Zone Represented (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>North East</td>
</tr>
<tr>
<td>Male</td>
<td>8 (80)</td>
</tr>
<tr>
<td>Female</td>
<td>5 (50)</td>
</tr>
<tr>
<td>Total</td>
<td>13 (72)</td>
</tr>
</tbody>
</table>

Round One of the Delphi Process

Sixteen of the original 18 expert panel members responded to round one of the Delphi process, for an 89% response rate. Two respondents skipped large sections of the survey and were sent an email indicating the specific areas in which the data were missing. Each was given an additional two days to complete the questionnaire. Both returned completed questionnaires within the given timeframe. Several respondents did not answer one or two questions. Statistical analysis was based on the number of responses for each question. Within three days of the close of round one, feedback was provided on the study web page (www.u.arizona.edu/~jculley). All panel members were
sent an email (Appendix N) indicating that the data from round one had been analyzed and were available for their review on the study web page under the Round One Feedback link. See Appendix O for a copy of the feedback placed on the web page. Feedback included: histograms depicting the responses for each construct, relationship and indicator in the model; tables summarizing the median responses, spread of scale points and status of consensus for each construct and relationship; tables summarizing the percent agreement and status of consensus for each indicator; all comments (de-identified) submitted by respondents from any of the questions and a copy of the Mass Casualty Conceptual Model (MCCM) depicting the minimal revisions that were made based on responses and comments.

Round Two of the Delphi Process

Sixteen panel members were sent the link to round two of the Delphi process. Thirteen completed round two (response rate of 81%). Two panel members did not participate due to job responsibilities. Appendix L includes a copy of the Second Round Questionnaire. One member skipped large sections of the survey and was sent an email indicating the specific areas in which the data were missing. The questionnaire was completed within the given time frame. Once again several panel members skipped one or more questions. Statistical analysis was based on the number of responses for each question. The criteria for consensus and/or stability were satisfied for all constructs, relationships and indicators during round two.

Within five days of the close of round two, feedback was provided on the study web page. All panel members were sent an email (Appendix P) indicating that the data
from round two had been analyzed and was available for their review on the study web page (www.u.arizona.edu/~jculley) under the Round Two Feedback link. (See Appendix Q for a copy of the feedback placed on the web page). Feedback for both rounds was summarized and included: histograms depicting the responses for each construct, relationship and indicator in the model from round two; tables summarizing the median responses, spread of scale points, stability percent and status of consensus/stability for each construct and relationship from both rounds; tables summarizing the percent agreement, stability percent and status of consensus/stability for each indicator from both rounds; and all comments (de-identified) submitted by respondents from any of the questions from round two.

Summary of Data from Round One and Round Two of the Delphi Process

Tables 7-9 summarize the statistics from rounds one and two of the Delphi process. The criteria for consensus were satisfied when the interquartile range for scores was of no more than one scale point. Stability was calculated for items that did not reach the criteria for consensus during round one. Stability was met when the change in the distribution of mean responses was less than 15% from round one to round two.

During round one, one construct and 19 indicators reached sufficient consensus to retain. Significant comments were made regarding the constructs, relationships and indicators. Comments are presented according to constructs, relationships and indicators recorded during round one of the Delphi process. The complete list of comments can be found in Appendix N. All de-identified comments were available on the web page for review and consideration by all panel members as a basis for their round 2 responses.
Table 7. Mean Responses, Interquartile Ranges, Percent Stability and Status of Consensus/Stability Related to the Constructs

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Mean Response Round 1</th>
<th>Interquartile Range Round 1</th>
<th>Mean Response Round 2</th>
<th>Interquartile Range Round 2</th>
<th>Stability Round 1 to Round 2 (%)</th>
<th>Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs</td>
<td>4.94</td>
<td>3.00-6.25</td>
<td>5.00</td>
<td>4.00-6.00</td>
<td>1.21</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity</td>
<td>5.81</td>
<td>5.00-7.00</td>
<td>5.46</td>
<td>5.00-6.00</td>
<td>-6.00</td>
<td>Consensus and Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Environmental Context</td>
<td>5.94</td>
<td>5.00-7.00</td>
<td>5.92</td>
<td>5.00-7.00</td>
<td>-0.28</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Patients</td>
<td>5.56</td>
<td>5.00-6.25</td>
<td>6.00</td>
<td>6.00-7.00</td>
<td>7.91</td>
<td>Consensus and Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Resources</td>
<td>5.88</td>
<td>5.75-6.25</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Consensus Satisfied to Retain Round 1</td>
</tr>
<tr>
<td>Workforce</td>
<td>5.63</td>
<td>5.00-6.25</td>
<td>6.08</td>
<td>6.00-7.00</td>
<td>7.94</td>
<td>Consensus and Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Information Technology</td>
<td>4.50</td>
<td>3.50-6.00</td>
<td>4.77</td>
<td>4.00-6.00</td>
<td>5.98</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Structure</td>
<td>5.25</td>
<td>4.75-6.00</td>
<td>5.00</td>
<td>4.00-6.00</td>
<td>-4.76</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Triage</td>
<td>5.94</td>
<td>5.75-7.00</td>
<td>6.15</td>
<td>6.00-7.00</td>
<td>3.60</td>
<td>Consensus and Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Outcomes</td>
<td>5.60</td>
<td>4.50-7.00</td>
<td>5.45</td>
<td>5.00-6.50</td>
<td>-2.60</td>
<td>Stability Satisfied to Retain Round 2</td>
</tr>
</tbody>
</table>
Table 8. Mean Responses, Interquartile Ranges, Percent Stability and Status of Consensus/Stability for Relationships

<table>
<thead>
<tr>
<th>Relationships</th>
<th>Mean Response Round 1</th>
<th>Inter-Quartile Range Round 1</th>
<th>Mean Response Round 2</th>
<th>Inter-Quartile Range Round 2</th>
<th>Stability Round 1 to Round 2 (%)</th>
<th>Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs as an influence on the Information Technology environment</td>
<td>4.44</td>
<td>2.75-6.00</td>
<td>4.00</td>
<td>3.00-5.00</td>
<td>-9.91</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity as an influence on Information Technology environment</td>
<td>4.38</td>
<td>3.00-5.25</td>
<td>4.23</td>
<td>3.00-5.00</td>
<td>-3.41</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Environmental Context as an influence on the Information Technology environment</td>
<td>4.94</td>
<td>4.00-6.00</td>
<td>4.62</td>
<td>3.00-6.00</td>
<td>-6.57</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Patients as an influence on Information Technology environment</td>
<td>4.69</td>
<td>4.00-6.00</td>
<td>4.75</td>
<td>3.00-6.25</td>
<td>1.28</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Resources as an influence on Information Technology environment</td>
<td>5.00</td>
<td>4.00-6.00</td>
<td>5.50</td>
<td>5.00-6.00</td>
<td>10.00</td>
<td>Consensus and Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Workforce as an influence on Information Technology environment</td>
<td>5.44</td>
<td>4.00-6.25</td>
<td>5.38</td>
<td>5.00-6.00</td>
<td>-1.02</td>
<td>Consensus and Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Information Technology as an influence on the fit to Structure</td>
<td>4.88</td>
<td>4.00-6.00</td>
<td>4.83</td>
<td>4.50-6.00</td>
<td>-0.96</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Structure as an influence on Triage</td>
<td>5.19</td>
<td>4.75-6.00</td>
<td>5.33</td>
<td>4.00-6.25</td>
<td>2.76</td>
<td>Stability Satisfied Retain Round 2</td>
</tr>
<tr>
<td>Triage as an influence on Outcomes</td>
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Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability for Indicators for Each Construct

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Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability Related to the Indicators for Each Construct (continued)

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Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability Related to the Indicators for Each Construct (continued)

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Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability Related to the Indicators for Each Construct (continued)

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Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability Related to the Indicators for Each Construct (continued)

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<th>Construct Indicators</th>
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Table 9. Percent Agreement, Percent Stability and Status of Consensus/Stability Related to the Indicators for Each Construct

(continued)

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<th>Construct Indicators</th>
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</table>
Comments Related to Constructs

During round 1, the panel suggested a number of additions to constructs: One suggested structuring the model in terms of immediate outcomes, (days of treatment), mid term, and long term outcomes. Others suggested including the level of prior preparedness training, “clear norms on the ground,” community disaster plans in place, safety measures in place for both patients and providers, communication capability, injury severity, access to patients, and pre-ED triage. Other additions suggested were the political environment and “exercising” (reviewing each component for strengths and weaknesses and changing as needed). The Resource construct sufficiently satisfied the criteria for consensus and was removed from round two consideration. All suggestions were available on the web page for review and consideration by panel members.

Comments Related to Relationships

Panelists suggested a number of additions or changes to relationships. Comments included: IT should be included within context, preplanning and training should be a construct, and that Triage and Resources should be more highly placed than it is in the Workplace Construct. It is worth noting that some experts felt that the order in which constructs were listed was in terms of importance and suggested reordering. One panelist suggested that triage can be collapsed onto structural environment. Since none of the relationships sufficiently satisfied the criteria for consensus, all nine relationships were again presented during round two. All de-identified comments were available on the web page as a basis for the panel’s round two responses.
Comments Related to Indicators for Each Construct

Comments related to indicators for each construct are summarized below by construct. All de-identified comments were available on the web page as a basis for the panel’s round two responses.

Organizational Customs Indicators.

Panelists suggested including prior experience by organizations in dealing with mass casualty events. One noted the importance of feedback and thought that shared beliefs was potentially problematic in situations requiring “black/white decisions.” Another argued that patient priorities should be addressed before MCI happens. Only the Leadership Style indicator sufficiently satisfied the criteria for consensus and was removed from round two consideration. All comments were available on the web page for review and consideration by panel members.

Triage Unit Organizational Complexity Indicators.

One panelist suggested more emphasis on skill mix rather than “specialties in workforce.” Technology changes proposed included: integrating tech readiness into technology abilities, clarifying “high tech nature” of organization or changing it to “technological sophistication” of organization. Other suggestions related to staff preparation, such as: maximal cross training of personnel, and familiarity/proficiency with available triage algorithms and modalities. One panelist suggested that “team culture” might not be as appropriate as “team synergy,” which comes from consistent, standard training. Size and Team Culture sufficiently satisfied the criteria for consensus
and were removed from round two consideration. All comments were available on the web page for review and consideration by panel members.

*Environmental Context Indicators.*

Several changes in how disasters were categorized were suggested (e.g., as state, regional, national and international levels; as natural vs. man-made; and as natural, unintentional, or deliberate). On panelist felt that the list of disasters was missing numerous events and suggested using the list put forth by CRED. Other additions to Environmental Context proposed included weather and competing (simultaneous) disasters. Nature of Disaster, Geographical size, Duration, and Warning Systems sufficiently satisfied the criteria for consensus and were removed from round two consideration. The model was modified to reflect the CRED list as well as the revision of terminology to indicate natural, unintentional and deliberate events. The revised model was presented to the panel for review during round two. All comments were available on the web page for review and consideration by panel members.

*Resources Indicators.*

Recommended changes focused on the cost, 24/7 availability of resources, as well as the transportation needs (logistics) to obtain necessary resources. One panelist suggested that key resources be listed for each type of disaster. Categories and Location sufficiently satisfied the criteria for consensus and were removed from round two consideration. The Amount indicator was renamed to the more inclusive term of Availability and presented in the revised model for round two consideration. All
comments were available on the web page for review and consideration by panel members.

*Workforce Indicators.*

Several panelists questioned the inclusion of age as an indicator. One saw overlap in the separate indicators for education, credentials, and licensure. One was not clear on what was meant by “experience with technology” or “skill mix.” Another recommended that credentialing be addressed within “Triage Level Organizations Complexity Indicators.” One panelist suggested changing revising 'needs related to safety and health' to 'willingness to work’ based on literature suggesting that “health care personnel may not be willing to work in all disaster situations.” Others suggested adding “physical health, disability and handicap.” Experience and Training sufficiently satisfied the criteria for consensus and were removed from round two consideration. All comments were available on the web page for review and consideration by panel members.

*Information Technology (Technology) Indicators.*

One panelist suggested that the data that would be needed was event driven. Two panelists suggested including power and connectivity needs, as well as alternatives when power is not available. One felt that ergonomics was not as important during an incident. Another panelist suggested that workforce needs to be familiar with an organization’s data collection systems, as well as the backup system. For one panelist, the entire category was unclear so he/she requested a better way to explain the technology and/or information that would affect triage. Work flow sufficiently satisfied the criteria for
consensus and was removed from round two consideration. All comments were available on the web page for review and consideration by panel members.

*Information Technology (Information) Indicators.*

Various panelists suggested adding information accuracy, access and availability, communication of system changes to end users, redundant data storage, security (both of information and of servers), and the use of standard nomenclatures. Currency and Access were presented in the revised model for round two consideration. All comments were available on the web page for review and consideration by panel members.

*Structure Indicators.*

One panelist suggested that the “degree of hierarchical needs” needed to be further developed and made more concrete; another seemed to agree, commenting that the “wording is too generic and needs to be easier for the first responder to adapt to.” Another panelist wondered how to measure “search behaviors.” Work Flow and Search Behaviors sufficiently satisfied the criteria for consensus and removed from round two consideration. All comments were available on the web page for review and consideration by panel members.

*Triage Indicators.*

Panelists focused on the need for feedback, both on resources, as well as on the success of referrals (i.e., whether victims’ needs were met). All three indicators of Time to Triage, Classification, and Prioritization sufficiently satisfied the criteria for consensus and were removed from round two consideration. All comments were available on the web page for review and consideration by panel members.
Outcomes Indicators.

One panelist suggested that the category be titled “Estimation of Injuries” because outcome indicators couldn’t predict outcomes. Another suggested including whether victims’ needs were met. Another panelist suggested that the model be extended beyond immediate triage outcomes. One person suggested that “overtriaging” should be the norm. All comments were available on the web page for review and consideration by panel members.

Changes were made in the model before submitting the model for round two of the Delphi process. Appendix N includes a copy of the revised model that was used as a basis for the round two questionnaire. The indicators under the Environment Context construct were modified in round two to be more reflective of recent research (Perrow, 2006) that supports the use of the terms Natural, Unintended and Deliberate in place of Natural and Man-made when describing the nature of disasters. The indicator of Amount under the Resource Construct was also changed in round two to Availability to be more inclusive.

During round two, the criteria for consensus and/or stability were satisfied for all elements of the model. Panelists made a number of comments and suggestions, which are summarized below. The complete list of comments can be found in Appendix Q.

Comments Related to Constructs

One panelist suggested adding “Equipment,” another suggested including resources, medical supplies, medical support, and transportability. Two protested that outcomes cannot affect outcomes so that section needs to be integrated with another
construct. Some panelists supported suggestions made by other panelists in round one, such as the inclusion of Community Disaster Preparedness Plans or the level of preparedness and routine “exercising” (quality improvement); and the addition of the political environment. One suggested that training was sufficiently important to include as a construct. Another noted the importance of resources on outcomes. There continued to be some confusion about the listing of items, at least one person assumed that these were ranked in some priority order.

Comments Related to Relationships

One panelist suggested that Community Disaster Plans influence all of the constructs. Another stated that information and technology should be distinct concepts, suggesting that the technology definition was too broad. A third suggested that triage is critically important for outcomes, but relates to the overall process, not to the items listed in the model under outcomes.

Comments Related to Indicators for Each Construct

Comments provided in the response section of the round two questionnaire related to the indicators for each construct are discussed below according to construct:

Organizational Customs Indicators.

One panelist suggested that triage prioritization needs to be clear; two suggested that “belief in the methodology” may not be the right term. Another agreed with a round one comment that punishment/reward and feedback aren’t applicable in these situations.
Triage Unit Organizational Complexity Indicators.

One panelist agreed on emphasizing “skill mix” rather than “specialties in workforce.” The same panelist suggested combining tech readiness with high tech as “technology abilities.” Another suggested that organizational knowledge and experience of similar events is important. Other first round suggestions that received support from panelists in round two include changing “high tech nature of organization” to “technological sophistication of organization,” adding cross-training for adaptability, proficiency in triage algorithms and procedures, inclusion of “exercising,” and use of “team synergy” rather than “team culture.” One panelist suggested including the number, proportion and relevance of specialties in the workforce. Another suggested that the “high tech nature of an organization” might be an indicator, but needs to be expanded because some low tech organizations achieve excellent outcomes.

Environmental Context Indicators.

Panelists suggested including “suburban” but one felt that proximity to the disaster and distance to other health facilities was more important. Others supported the classification of disasters as natural, unintentional, or deliberate, and supported the idea of a disaster as a disrupted social system. Another environmental factor suggested as a potential indicator was the organizational/financial structure of the facility. Weather also was supported for inclusion in the model. Again, the use of the CRED list of disasters was suggested.


**Patients Indicators.**

Panelists again commented about preexisting conditions and two argued against round one comments that age and other demographics were not important. One panelist suggested “Patient Variability” as a more generic indicator. The suggestion during round one to change “medical” to “health” conditions, etc. throughout the model received support.

**Workforce Indicators.**

Two panelists supported the recommendation in round one to revise 'needs related to safety and health' to 'willingness to work’. Two agreed that there was overlap in education/credentials/licensure; one suggested that credentials/licenses should cover education and age is too variable to be useful. One suggested that competencies are more important than “skill mix, noting that diversity and competency were key. Again, estimated service time and consideration of physical health and disabilities should be included. One person recommended adding “confidence in leadership.”

**Information Technology (Technology) Indicators.**

One panelist supported the inclusion of Power and Internet availability, as well as connectivity. The idea that the event would determine what data to collect was also supported. One panelist remained unclear about work flow and rate flow.

**Structure Indicators.**

One panelist suggested using “lines of communication” rather than “spatial integration.” Another suggested that it was important to include the “ability of the organization to improvise.”
Outcomes Indicators.

One panelist noted that “death” should be included. Another commented that the most important indicator should be whether the victims’ needs were met.

Summary of Comments

All comments were reviewed from both rounds of the Delphi process to determine if: a) the concept, relationship or indicator was already included in the model or Glossary of Terms; b) the comment was supported or rejected by other panel members; and/or c) the literature or underpinnings of the model supported rejecting, retaining or modifying the concept, relationship or indicator. Comments were then compared with the statistical analysis related to consensus and/or stability and the model revised if appropriate.

Figures 10 to 18 represent the revised model after the final round of the Delphi process.
Figure 10. Validated Mass Casualty Conceptual Model (MCCM)
Figure 11. Validated MCCM Stage I: Contextual Environment - Organizational Customs
**Figure 12.** Validated MCCM Stage I: Contextual Environment - Triage Unit Organizational Complexity

Shaded boxes indicated revisions to the model
Figure 13. Validated MCCM Stage I: Contextual Environment - Environmental Context
Figure 14. Validated MCCM Stage I: Contextual Environment - Patients, Resources and Workforce
Figure 15. Validated MCCM Stage II: Information Environment
Figure 16. Validated MCCM Stage III: Structural Environment

Figure 17. Validated MCCM Stage IV: Triage
Figure 18. Validated MCCM Stage V: Goals
The data indicated the greatest support for change in the following areas: ensuring that teams are well prepared, healthy, skilled in the use of existing protocols, willing to work and very adaptable; including disaster planning and exercises/drills as an integral part of preparedness and response; revising disaster categorization to represent natural, unintended and deliberate disasters; consider the relevance of proximity to disasters and distance to health care facilities as more reflective of the environmental context than the urban or rural nature of the setting; developing an information/technology environment that provides for redundancy, connectivity, currency, access and utility power sources; and including safety of both patients and workers as important outcome indicators.

Usefulness of the Model and Online Delphi Process

The round two questionnaires included an evaluation of the usefulness of the model for the further study of information and technology requirements during mass casualty events and eight questions evaluating each component of the online Delphi process. Experts used a 7-point Likert scale, where ‘1’ represented not useful and ‘7’ represented very useful to answer these questions. Table 10 summarizes data related to the usefulness of each component of the online Delphi process.

<table>
<thead>
<tr>
<th>Online Processes Used in the Study</th>
<th>Mean Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webpage</td>
<td>6.00</td>
</tr>
<tr>
<td>Narrated Instructions about the Delphi Process</td>
<td>5.50</td>
</tr>
<tr>
<td>Narrated Explanation of the MCCM</td>
<td>6.20</td>
</tr>
<tr>
<td>Online Glossary</td>
<td>6.40</td>
</tr>
<tr>
<td>Online Questionnaires</td>
<td>6.10</td>
</tr>
<tr>
<td>Online feedback</td>
<td>6.20</td>
</tr>
</tbody>
</table>

* Rated from 1 = Not Important To 7 = Critically Important
Panelists’ comments were also informative:

- “It was difficult to flip back and forth between the comments and the second round questions. Place the comments directly with the round 3 questions. We can cut and paste or indicate which comments we agree with or would like to expand on.”
- “The variability in computers made the slides for the model narration difficult to follow. There were no control bars that allowed for moving ahead or backing up, at least as I was able to access it.”
- “Not to be picky....the font was a bit small. I would list the numbers above the columns....with the terms "not useful"....all the way up to "very useful". #s might mean different things to different people.”

Figure 19 summarizes responses related to the usefulness of the model to further research. The mean response was 5.3 on the 7-point Likert scale.

![Figure 19. Usefulness of the Model to Further Research]
Comments related to the useful of the model to the further study of information and technology during mass casualty events included:

- “Depends on consensus among the (hopefully) wide range of respondees; if Incident Commanders, Nurses, Emergency Responders, and Technical providers all see the model as something they can build on, then it is a success. If One Essential Party declares it as not useful, then the model will have a quirk, because all need to be involved.”
- “The model would be useful in the study of IT utilized during Mass Casualty events but IT need not be present to have successful triage!”
- “This is a sophisticated model that captures complex elements in a logical manner.”
- “I look at this model from a few different perspectives. As a nurse, the model seems to be a bit "expanded". Yes there are factors and conditions that will effect patient outcome...but in today's response world, Management Systems are being created and utilized to increase positive patient outcomes during a mass casualty event. I do believe resources, that include the workforce, need to be competent and available.....this two factors, in my opinion are the greatest factors. We need the right people and have available the right resources available.”

Respondents were also asked to estimate the time needed to complete each questionnaire. SurveyMonkey provided information regarding the amount of time that each respondent was logged onto the site for each questionnaire. However, time logged-on versus the time actually involved in working on the questionnaire was not available. The mean minutes reported by the respondents to complete round one was 71 minutes versus 63 minutes recorded by SurveyMonkey. The mean minutes reported by the respondents to complete round two was 47 minutes, versus 22 minutes recorded by SurveyMonkey. Two respondents completed each round over two days, and one respondent completed round two in over five hours.
Summary

Chapter IV summarized the data collected through the two rounds of the Delphi process. The criteria for consensus and/or stability were satisfied for all elements of the model. The revised model was presented. The usefulness of the model, as well as an evaluation of the computerized Delphi process was also discussed.
CHAPTER V: DISCUSSION AND RECOMMENDATIONS

Introduction

What are the factors or variables that make a difference between life and death or disability for victims of natural, unintentional or deliberate disasters? Extant literature and existing theoretical models provided the basis for the development of a novel conceptual mass casualty model. The purpose of this research was to conduct a Delphi study to validate the model. Being able to identify and describe the very complex series of events and contextual factors or conditions that influence the way we respond to disasters provides the first step in understanding these complex phenomena and affords the opportunity to explore models that represent the phenomena at play during mass casualty events. This chapter discusses the results and the implications of this study, as well as limitations and directions for future research in the area of mass casualty triage. Results are presented by research question.

Discussion of Results and Implications

Four research questions were addressed in this research. Three of the questions explored the constructs, relationships and indictors that most appropriately influence outcomes of care during mass casualty events. The fourth question addressed the usefulness of the model to the further study of information and technology requirements during mass casualty events. During the second (final) round of the Delphi process, experts also were asked to evaluate the effectiveness of the online processes used in the study.
The expert panel recorded many comments during both rounds of the Delphi process. Comments from round one were made available (via the study web page) to experts for review while responding to the second round of the Delphi process. Comments recorded during round two were not available to the panel of experts until the close of the Delphi process. Comments from round two were used to validate comments from the previous round but were not available for further remarks by the experts. Results pertaining to each of the research questions are discussed below.

Research Question One

The first research question asked “to what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?”

All ten constructs satisfied either consensus and/or stability criteria to retain the constructs. Experts’ comments were used to refine construct definitions. The Glossary of Terms in Appendix J displays revisions to the original definitions for each construct, relationship and indicator.

Only one of the constructs, Resources, sufficiently satisfied the criteria for consensus during round one of the Delphi process. During round two, four of the constructs Triage Unit Organizational Complexity, Patients, Workforce, and Triage sufficiently satisfied the criteria for consensus and stability and the remaining five constructs Organizational Customs, Environmental Context, Information Technology, Structure, and Outcomes satisfied stability criteria. Stability statistics indicated movement in opinion among the experts between rounds, particularly related to Triage
Unit Organizational Complexity (-6% change), Patients (8% change), Workforce (8% change), and Information Technology (6% change). However, all fell within the acceptable range for stability and were retained in the model. Linestone and Turoff (2002) note that stability measures similarity of responses across rounds and a point of diminishing returns is usually reached after a few rounds; further rounds generally show very little change.

Many of the comments recorded by the panel of experts referred to components of the model that were already included in the model and defined in the Glossary of Terms (Appendix J). Examples include ‘pre-hospital triage’ that is included in the Triage construct under the Time to Triage indicator; ‘severity of injury’ included under the Patient construct under the Injury indicator; and ‘ability to use existing technology’ included under the Workforce construct under the Experience with Technology indicator.

One expert discussed research that conceptualizes disasters as the effect of an agent or event on a vulnerable human society (Pielke, 2006). That is, the “disaster is not the tornado or flood itself, but the disrupted human social system.” This view conceptualizes disasters as a social disruption and a power loss as one indicator of a disaster but a hurricane and flood as the cause of the disaster. Only one other expert responded to this comment and agreed with the perspective.

One expert felt that Information and Technology should not be mixed together and that the definition being used for Technology seemed too broad. Based on input from other experts, the definition was modified (Appendix J, Glossary of Terms) to include such aspects as access to utility power sources to operate equipment, redundancy and
connectivity. Another expert felt that Overtriage should always be the norm. This is a perplexing comment, given the need to set priorities in situations where causalities overwhelm resources if we are to do the greatest good for the greatest number (Fryberg, 2002; Hoey & Schwab, 2004; Kilner, 2002).

Several experts indicated the need to expand the triage time frame to include not only immediate acute health outcomes, but also more long-term outcomes. Long-term outcomes include complications related to long term health effects and safety as well as quality of life issues. However, the focus of this model is the acute triage time frame. There are many additional factors that should be considered in a model that takes into consideration outcomes that occur several months or years after a disaster. This was beyond the scope of this conceptual model but warrants further study.

One expert commented that “an organization’s structure should be included as an indicator rather than a construct since the Incident Command System (ICS) is required to be integrated into all hazard planning, providing clearly defined roles, responsibilities and systems for a unified streamlined response.” While this is the goal of ICS, the efficacy of this structure is yet to be evaluated. The August, 2005 Katrina hurricane that reeked havoc on the gulf coast of Louisiana, Mississippi and Alabama killing more than 1000 people and leaving only 50 percent of hospitals in the area open one year later is an example of the need to evaluate the efficacy of the ICS structure. Structure was retained based on a -5% change from round one.

Structural Contingency Theory (SCT) describes the relationship between structure and contingency factors within and outside of the organization. Structure from this
theoretical perspective describes the organizational framework needed by each triage unit
(from hierarchical to flexible) to support the needs of the workforce in managing the
diverse needs of each patient. Using the theoretical underpinnings of SCT, structure is
viewed as a construct and not an indicator. Further research is indicated to clearly
evaluate the appropriateness of this construct. Figure 20 depicts the MCCM as validated
by the panel of experts.

Research Question Two

The second question addressed “to what extent do experts agree that the proposed
relationships among the constructs presented in the model provide valid representations
of mass casualty triage?”

All nine relationships in the model sufficiently satisfied the criteria for either
consensus and/or stability to retain the relationships during the second round of the
Delphi process. The lowest mean was 4.0 during round two for the Organizational
Customs as an influence on the Information Technology environment relationship. The
largest interquartile ranges were reflected in the Environmental Context as an influence
on the Information Technology environment (3.00-6.00) and Patients as an influence on
the Information Technology environment (3.00-6.25), however both sufficiently satisfied
the criteria for stability and were retained. The contribution of these relationships to the
model warrant further study and model testing to fully evaluate the theoretical
underpinnings of the relationships in the model.
Figure 20. The Validated Mass Casualty Conceptual Model (MCCM)
Relationships appeared to pose the greatest difficulty for the expert panel. The influence of Organizational Customs and Resources on the Information Technology environment (10% change) and Resources as an influence on the Information Technology environment (10% change) showed the greatest movement from round one to round two. Several experts identified the need to determine which constructs are of the greatest importance. The presentation of the ten constructs in a column along the left side of the model seemed to indicate a priority level for some of the experts rather than using the horizontal arrows as the hierarchical structure for the relationships. This is reflected in one comment that “some of the items addressed in the individual constructs are very low on the importance scale”. Although this is a convention that is often used, the confusion may be related to the diversity of the expert panel and lack of experience in understanding theoretical models. The organization of the constructs may need to be made more explicit when presenting the model in future research.

One expert suggested that “IT should be part of the contextual environment rather than its own stage.” Another expert suggested that “triage can be collapsed into structural environment because how it is organized definitely reflects on later outcomes.” However, these perspectives were not supported by other experts. A third expert commented that “Community Disaster Plans influence all of the constructs.” The inclusion of Community disaster plans are addressed under the indicators for this construct. All relationships were retained. However, further research is needed to evaluate the contributions of structural contingency theory and technology theory as appropriate theoretical underpinnings for the contingency factors represented by the constructs and relationships in the model.
Research Question Three

The third question asked “to what extent do experts agree that the proposed indicators for each construct represent appropriate measurements for the constructs?” The indicators are discussed by construct below.

Organizational Customs Indicators.

Leadership Style and Team Culture indicators satisfied the criteria for consensus during round one; Shared Beliefs and Life Cycle indicators satisfied the criteria for stability during round two. Between rounds one and two, experts chose to delete Incentive Structure as an indicator as indicated by a -14% change and a split 46 percent agreement to retain or delete. Incentive Structure was removed as an indicator for the construct. Several experts believed that “disaster planning is a critical component of an organization.” The Joint Commission on Accreditation of Healthcare Organizations (JCAHO, 2003) requires every healthcare facility to create and exercise disaster plans in their facilities. Hospitals also implement the Hospital Emergency Incident Command System (HEICS) that provides structure for their disaster plans. Disaster Planning was added as an indicator to reflect current trends and requirements in disaster planning for healthcare institutions.

Another expert felt that “patient priorities should already be addressed before a mass casualty incident actually happens and is done during mass casualty training long before an incident happens.” This comment relates to the levels of priorities that are addressed in institutional disaster plans. However Berkowitz (2002) and Downing (2002) point out the need to improve emergency preparedness and the healthcare response to
mass casualty. This is supported by the work of Simon and Teperman (2001) who noted that during the September 11, 2001 attacks on the World Trade Center communication between on-the-scene coordinators and hospitals was almost nonexistent. The research indicates it is not always possible to determine, prior to a large catastrophic incident, just how priorities will be determined and most importantly how they will be communicated. Priorities may change when large numbers of casualties overwhelm existing healthcare resources. Many other comments were recorded by the experts during both rounds of the Delphi process but were not supported by other experts. The Glossary of Terms was modified to include the disaster planning revision. Figure 21 depicts the revision made to include Disaster Planning as an indicator for this construct.

Figure 21. Organizational Customs Indicators

*Triage Unit Organizational Complexity Indictors.*

Triage Unit Organizational Complexity indicators generated several comments. One expert questioned the High Tech indicator, arguing that “triage algorithms exist that
define treatment procedures. Team members should be ‘proficient’ in the triage/treatment modalities.” Gebbi et al. (2002) and Weckerle et al. (2001) point out the need for consistent competencies for emergency care providers. The lack of consistency has resulted in a very diverse emergency provider workforce in terms of their educational preparation, experience, knowledge, skills, credentials/certifications and training. While the High Tech indicator satisfied the criteria for consensus to modify during round two, expert comments were very diverse and did not provide sufficient direction to modify the indicator. This indicator warrants further study.

Size and Team Culture indicators sufficiently satisfied the criteria for consensus during round one. Several experts strongly felt that standardized training drills or exercises have a tremendous influence on outcomes as related to team culture. This was supported by the regulations set up by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO, 2003) that requires hospitals to perform drills as a component of their emergency management plan. Exercises/Drills was added to the Team Culture indicator to reflect the frequency, quality and standards of exercises and drills that are required to take place within an organization. The Glossary of Terms was modified to include this revision.

Although Number of Specialties sufficiently satisfied stability criteria (-3% change), experts commented that the relevance of specialties in the workforce is more critical than just evaluating the number of specialties stating that “having 5 specialties, but 4 of them totally irrelevant to the event is less useful than having only 2 specialties.”
The inclusion of Relevance as an indicator of Number of Specialties warrants further study. Figure 22 depicts the revision made to indicator for this construct.

*Environmental Context Indicators.*

During round one of the Delphi process, all but one of the indicators sufficiently satisfied the criteria for consensus and was retained. The indicators were modified after round one to be more reflective of recent terminology (Perrow, 2006). Natural and Man-made were replaced with Natural, Unintended and Deliberate when describing the nature of disasters. Indicators for Natural, Unintended and Deliberate Disasters were modified to include Fires, Volcanoes, Flood or Slides and Extreme Temperature to incorporate all possible disasters.

Several experts felt that the terms of urban, and rural are not universally defined and less important than proximity to the disaster and distance to other health facilities. The model was modified and the terms urban and rural replaced with Proximity to the
Disaster and Distance to Health Facilities. Competing disasters,” e.g., in the same state or area, also pose resource issues and was added as an indicator to the model under this construct. The Glossary of Terms was modified to include these revisions. Figure 23 depicts revisions made to indicators for this construct.

*Patient Indicators.*

Injury and Variability indicators sufficiently satisfied consensus criteria during round one. There was diversity of opinion by the experts related to the Demographics

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**Figure 23. Environmental Context Indicator**

[Diagram showing various indicators and classifications related to environmental context and disaster types]
indicator. Concern was raised about superimposing patients with existing disabilities and chronic disease on disaster effect outcomes. The Demographics indicator as defined in the Glossary of Terms, already captures contributing health care conditions that influence survivability. Demographics, as already defined in the model were intended to capture the specific needs of the disabled, frail elderly, etc. Another expert indicated that demographics are vital to consider in the model, stating that “if a facility has a large number of pediatric, geriatric or other groups of victims and lacks appropriate plans and caregivers, care quality will be degraded.” There was considerable variation in responses from round one to round two with 20% change between rounds resulting from a 56% agreement to retain this indicator in round one to an 85% agreement to retain the indicator in round two.

Another expert argued that “…injury type and number and demographics are not necessary factors. You deal with what you have. Age and gender are not something we should take into consideration.” Most emergency plans provide guidance for the triage of specific age groups such as children. For example, Engum et al. (2000) point out that the triage of children requires special consideration methods. The Demographics indicator was retained, with an 85% response to retain during round two.

One expert strongly recommended changing the use of ‘medical condition’ to a more inclusive term (e.g., ‘health condition’ and ‘health care’). Health is a more global term that is more inclusive of nursing and used by a number of nursing and health care organizations. The American Nurses Credentialing Center (ANCC) uses the term health care in the credentialing of Informatics Nurse (ANCC website); the American
Association of College of Nursing uses the term health care in their Essentials of Baccalaureate Education for Professional Nursing Practice (1998); and the Institute of Medicine refers to the term health care in several of their documents (1999, 2001, 2003). These terms were changed in the model and Glossary of Terms. All indicators were retained. Figure 24 depicts the indicators for this construct.

Figure 24. Patient Indicators

*Resources Indicators.*

All indicators under the Resource Construct were considered by experts to be important to the model. The Amount indicator was changed in round two to Availability to be more inclusive and satisfied the criteria for consensus with a 100% retention rating. Other comments made by the experts during rounds one and two included indicators that either were already incorporated into the model or described in the Glossary of Terms or were not supported by other experts during the second round of the Delphi process. The Glossary of Terms was modified to include Availability. Figure 25 depicts the revision made to the indicator for this construct.
Many comments were made under the Workforce indicators. The original indicator Needs Related to Safety and Health was changed to Willingness to Work based on an emerging body of science (Rosenfeld, et al. 2007) that indicates that health care personnel may not be willing to work in all disasters. Concerns about health and personal safety are only two of the reasons that should be considered. Concerns for pets, family members and fear, among other issues, should be considered under this construct.

Seventy percent of the panel agreed that Age should be eliminated as an indicator, and supporting comments strongly advocated for the removal of this indicator. Experts commented that the physical health of the workforce and their competencies should also be considered so these were added to the construct. Several experts felt that skill mix should be modified to include competencies and cross training; these indicators were added to the skill mix indicator. The Experience indicator sufficiently satisfied the criteria for consensus in round one. Credentials/Licenses satisfied the criteria for consensus during round two with a 92% to retain, but this indicator showed significant movement between rounds with only 16% change. All of the other indicators sufficiently
satisfied the criteria for consensus and/or stability. The Glossary of Terms was modified to include these revisions. Figure 26 depicts revisions to indicators for this construct.

Figure 26. Workforce Indicators

*Information Technology (Technology) Indicators.*

There was a great deal of discussion around the Information/Technology Construct. One expert felt that ergonomics is not a concern at the time of an incident; this was not supported by other panel members. Several experts indicated that there is a need to consider redundancy, utility power needs and connectivity for computer applications. The Characteristics indicator sufficiently satisfied the criteria for stability at -5% but there was only 39% agreement to retain with a 39% agreement to modify the indicator during round two. Vicente (2004) discusses the significance of these factors and believes they provide the foundation for technology tailored to the human factors that govern behavior. Access to utility power, connectivity and redundancy were added to the model.
under the Characteristics indicator. All other indicators sufficiently satisfied the criteria for consensus or stability. The Glossary of Terms was modified to include these revisions. Figure 27 depicts revisions made to indicators for this construct.

Figure 27. Information Technology (Technology) Indictors

*Information Technology (Information) Indicators.*

All indicators under the Information Indicator sufficiently satisfied the criteria for consensus or stability. The Flow indicator met the criteria for consensus during round one. Terminology and Security indicators sufficiently satisfied the criteria for stability during round two and the Characteristics indicator sufficiently satisfied the criteria for both consensus and stability to retain during round two. Comments related to Characteristics indicated a need to include currency and access to information under this
indicator. The Glossary of Terms was modified to include these revisions. Figure 28 depicts revisions made to indicators for this construct.

Figure 28. Information Technology (Information) Indictors

Structure Indicators.

Many of the experts believed that the wording under the Structure indicator was too generic and needed simpler terms for clarity. All of the indicators sufficiently satisfied the criteria for consensus and/or stability. Work Flow Variability and Search Behaviors indicators satisfied the criteria for consensus during round one and the Structure indicator satisfied the criteria for both consensus and stability during round two.

Structure is a key component of the model, is highly abstract, and reflects the underpinnings of structural contingency and technology theories. The ability of the model to predict the structure or work design needed at the triage unit level is predicated on all
of the contingency factors that influence this construct. Figure 29 depicts the indicators for this construct.

Figure 29. Structure Indictors

*Triage Indicators.*

All of the indicators sufficiently satisfied the criteria for consensus and stability during round one. One expert suggested adding Death as an additional indicator. This was not supported by other experts. Several of the experts indicated the need to expand the time frame to include the recovery period after a disaster. The scope of this model is limited to the acute care triage continuum of care. The ability to capture data through the recovery period in a mass casualty event warrants further study. Figure 30 depicts the indicators for this construct.

Figure 30. Triage Indictors
Outcomes (Patients) Indicators.

Both indicators sufficiently satisfied the criteria for consensus and stability during round two. These indicators were inadvertently omitted from the first round questionnaire. Figure 31 depicts the indicators for this construct.

![Figure 31. Outcomes (Patients) Indicators](image)

Outcomes (Resource) Indicators.

All of the indicators sufficiently satisfied the criteria for consensus and/or stability. The Undertriage indicator satisfied the criteria for consensus during round one and the Overtriage indicator sufficiently satisfied the criteria for consensus and stability during round two. Experts also expressed the need to include safety as an indicator of outcomes. Safety as a construct is supported by the research of Macintyre, et al. (2000) who discuss the importance of staff and facility protection, patient decontamination and the use of appropriate personal protective equipment during mass casualty events. Okumura et al. (1996) discuss the health issues experienced by the health care staff who treated the victims of the Tokyo Sarin subway attack. Landrigan et al. (2004) describe the significant health effects to rescue workers and citizens in New York as a result of the environmental exposures from the destruction of the World Trade Center in 2001. Safety includes the use of personal protective equipment and safety devices when appropriate to prevent workforce and patient injuries. Safety was added as a separate indicator under
this construct. The Glossary of Terms was modified to include these revisions. Figure 32 depicts revisions made to indicators for this construct.

![Diagram](image)

**Figure 32. Outcomes (Resource and Safety) Indicators**

*Research Question Four*

The fourth question asked “to what degree is the proposed model evaluated by experts as useful to the further study of information and technology requirements during mass casualty events?”

Experts rated the usefulness of the model to the further study of information and technology requirements during mass casualty events with a mean response of 5.3. Sixty-seven percent of the experts rated the useful of the model at five or greater on the 7-point Likert scale.

Experts made several comments regarding the usefulness of the model. One expert commented that “this is a sophisticated model that captures complex elements in a logical manner.” Another expert noted that:
The usefulness depends on consensus among the (hopefully) wide range of respondees; if Incident Commanders, Nurses, Emergency Responders, and Technical providers all see the model as something they can build on, then it is a success. If one essential party declares it as not useful, then the model will have a quirk, because all need to be involved.

The final comment reflected an interesting reflection about information technology. “The model would be useful in the study of IT utilized during Mass Casualty events but IT need not be present to have successful triage!”

The model represents preliminary research in determining the appropriate factors and the contributions each makes on outcomes of care during mass casualty events. Experts agreed on the importance of the constructs and relationships as valid representations of mass casualty triage. Indicators of these constructs were modified based on the responses and comments of the experts. Testing of the model will ultimately determine the validity and contribution of each component of the model to outcomes of care during mass casualty events.

*Usefulness of the Online Processes Employed in the Delphi Process*

Figure 33 illustrates the responses to the six questions that evaluated the online process used in the Delphi process. The mean response for Web page, Narrated Explanation of the MCCM, Online Glossary, Online Questionnaires, and Online Feedback were greater than six on the 7-point Likert scale. The Narrated Instructions about the Delphi Process scored a mean of 5.5 on the Likert scale. Responses indicated that the majority of panel members (83% - 92%) rated the online process used in this
Figure 33. Usefulness of Items in the Online Delphi Process

that the majority of panel members (83% - 92%) rated the online process used in this study above five on the 7-point Likert scale.

The study was conducted between July and August. Originally the study was designed to provide only one week for experts to respond to each round of questions. Several experts sent emails indicating they were on vacation and unable to access a computer and asked if they could have a little more time to complete the study. Both rounds of questionnaires were made available to the expert panel for an additional week to provide the opportunity for a greater response rate. The summer months were a factor that necessitated expanding the time required during each round of the Delphi process. The response rate for round one was 89% and the response rate for round two was 81%. 
The time between the two rounds in this study was three days. Feedback was made available on the study web page three days following the completion of round one. The round two questionnaire was made available at the same time the feedback was posted on the web page. This study supports the research conducted by Linestone and Turoff (2002) that showed that computer process used to distribute questionnaires can shorten the process between rounds. Experts scored the resources available on the web page favorably. Further research is indicated to support the use of web pages and online resources for the Delphi process.

Respondents reported an average of 71 minutes during round one and 47 minutes during round two to complete the survey. These averages were higher than the log-in time recorded by SurveyMonkey which was 64 minutes and 22 minutes respectively. SurveyMonkey logged one respondent in for only four minutes during each round of questionnaires. The 45-question multipart round one questionnaire and 39-question multipart round two questionnaire took considerable time to complete for most experts.

Limitations

The development of this conceptualization of mass casualty triage is still highly abstract and incorporates a systems approach to consider the broad context in which mass casualty events take place. The highly abstract and complex nature of the model, as well as the breadth and scope of the mass casualty context, may be difficult for such a diverse panel to comprehend and understand. Although recursive feedback processes can strengthen validity through consensus building (Powell, 2003), maintaining participants’
focus when large numbers of items (Custer et al., 1999) are included for consideration may affect concentration and response rates to individual questions.

Online web page resources and questionnaires were not accessible by two potential panel members due to server configuration restrictions established by their employer. They were therefore eliminated from the study. The exclusive use of Internet-structured processes may limit the inclusion of a representative sample.

The sample used in this research was a purposeful sample of 18 experts known to the researcher or recommended by panel members. The lack of randomization prevents the generalization of these findings to all hazards events. The diversity of the panel members and representation at all levels of emergency preparedness may be considered a strength as well as a limitation of this study.

Future Areas for Research

The findings presented in this dissertation are preliminary and exploratory. The MCCM provides a first step or a starting point in understanding the very broad context in which mass casualty events take place and in identifying the various variables that impact outcomes of care. The theoretical underpinnings of this model have yet to be fully validated as an appropriate framework for conceptualizing relationships in the model.

The perspectives of such a well-qualified and diverse expert panel provide a foundation for future research. The panel of experts validated constructs and indicators that can be used to develop tools for future model testing. Future areas for research include the development and testing of tools to evaluate further the theoretical underpinnings of the model, including each construct and relationship.
Opportunities for testing the model include simulations that use paper and pencil exercises, table top exercises, or manikins that can be programmed to characterize various injuries, ages and environmental influences. Retrospective studies can be designed to capture data after an unintentional, natural or deliberate event as well as prospective studies that have the potential to use surrogates such as the New York City or Boston marathons. Marathons traditionally use an Incident Command System and multiple triage stations to assess and treat multiple injuries and occasional fatalities.

The MCCM is a multi-level model with the focal level of research represented by Stages II, III, and IV. The strength of a multi-level model is its ability to allow researchers to model contextual effects and emergent relationships (Klein & Kozlowski, 2000). A multilevel perspective in organizational science affords a more integrated understanding of phenomena that unfold across levels in organizations (Klein & Kozlowski). Future research using multilevel modeling methodologies provides the opportunity to examine simultaneously the effect of individual-level as well as group level predictors on outcomes of care (Cho, 2003). Multilevel modeling techniques facilitate the statistical analysis of data sets with hierarchical structures such as those in the MCCM. Multilevel modeling provides the opportunity to study the contributions of each construct to outcomes of care during mass casualty events.

Online Internet and computer processes offer much promise for future research using the Delphi process or other questionnaire-based studies. Additional research is needed to adequately evaluate the effectiveness of online processes. Research that
evaluates the functionality and ease of access for online resources would provide additional insights into the use of this modality for future studies.

The scope of the MCCM is limited to the acute care triage continuum of care, but many experts in this study commented on the need to study outcomes of care that extend well beyond the acute phase of mass casualty events. Further research that explores variables that extend beyond the acute care phase of mass casualty events provides the opportunity to investigate morbidity and mortality factors affected by mass casualty events.

Summary

Mass casualty triage involves a complex health and multi agency system that takes place in a sociotechnical contextual setting characterized by multidisciplinary teams working together in a chaotic highly dynamic environment. The environment includes exceptions in workflow, uncertainties that permeate many decisions and the dependence upon clear, accurate, and speedy communication processes. The foundation on which to build policy and establish budgets for response to mass casualty events depends on the ability of policy-makers and stakeholders to comprehend the variables and relationships that have the greatest impact on outcomes of care during mass causality events.

Nurses perform strategic research, administrative functions and practice roles in emergency planning and mass casualty events. The foundation of our practice is based on the discovery of new knowledge and frameworks that provide the best evidence for care. A conceptual model may afford the opportunity to investigate the interactions between interdisciplinary teams and information technology systems to move science forward in
the area of emergency preparedness and ultimately maximize survival rates during times of mass casualty incidents.

The panel of experts validated a conceptual model that provides a foundation to better understand and study the complexity of mass casualty triage. The panel reached consensus and/or stability to retain all ten constructs, nine relationships and 39 out of 44 original indicators. Five indicators were modified, two deleted and six added to the final model. Additions and modifications to the model were based upon comments made by and supported by other panel members, current literature or underpinnings of the model.

This study provides a foundation for translational research that may offer insights and knowledge about the contribution of each of the complex factors that influence outcomes of care. Future studies have the potential to pose solutions to improve the efforts of the workforce and the systems that influence outcomes of care during catastrophic events.

The long-term goal of this research is the testing of a novel model for the triage continuum of care during mass casualty events. The model has the potential to predict the impact of each construct on outcomes of care and evaluate the accuracy of those predictions through model testing during mass casualty events.
APPENDIX A: VICENTE’S MODEL APPLIED TO THE MCCM
## Technology (Hardware or Software)

Location, cost, weight, size, shape, and materials used must be compatible with environmental contextual factors such as explosions, and/or chemical, radiological or biological exposures, etc. Technology might include the following:

- **Patient Tracking**
  - Patient triage tags via bar-coded wristband, electronic triage tags, paper tags, notes written on bandages, etc.
  - Software or paper systems that record patient's vitals, injuries, location, treatment, photo, identification information, etc.
  - Physiological sensors to measure and record vital functions such as oxygen saturation levels, pulse, respiration, blood pressure, etc.
  - GPS location and mapping of patients, resources and exposure to dangerous materials (chemicals, biologicals, etc.).
  - Mobile, secure triage information; including photos, GPS location and mapping
  - Redundant connectivity via wireless technology, radio, phone, walkie-talkie, ham radio, etc.
  - Decision support related to:
    - Best evidence for triage and treatment
    - Situational awareness of environmental factors, numbers of victims and their category codes, location of victims, workforce members, resources, etc.

- **Administrative functions**
  - Paper or electronic systems to handle:
    - Credentialing and organization of the workforce by specialty and work flow needs
    - Staffing all components of the system for the duration of the event
    - Prioritization and management of the transportation and treatment needs of patients
    - Logistics required to manage all of the resources needed

## Human Factors

**Physical**

Specific characteristics of the workforce related to strength, dexterity, and ergonomic requirements may require adjustments based on contextual factors such as the use of personal protective equipment that may limit dexterity, movement and visual field perception.

## MCCM Construct and Indicators

- **Information**
  - Technology Construct
    - Technology Indicators
      - Ergonomics
      - Functionality
      - Amount
      - Characteristics
    - Work Flow
    - Rate of Flow
  - Information Indicators
    - Terminology
    - Flow
    - Security
    - Security Characteristics
<table>
<thead>
<tr>
<th>Technology (Hardware or Software)</th>
<th>Human Factors</th>
<th>MCCM Construct and Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Security</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ability to interface with local, state, regional and federal emergency response and health care systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Protection of data via encryption or by other means during transit</td>
<td></td>
<td></td>
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<tr>
<td>- Ability to record data from a variety of sources</td>
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<td></td>
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<tr>
<td>- Ability to access, aggregate and audit data</td>
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</table>

The computer interface design or paper system design must consider the following variables that relate to specific needs of each member of the multidisciplinary teams:
- Information
- Content
- Structure
- Cause/effect relations

The structure of the data is dependent upon:
- Flow
- Terminology that is understood by all members of the multidisciplinary teams
- Amount
- Accuracy
- Completeness
- Access
- Security or access to specific data or information

<table>
<thead>
<tr>
<th>Psychological</th>
<th></th>
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<tbody>
<tr>
<td>Psychological factors consider such variables as cognitive workload, situational awareness, short and long term memory, and the types of information sought. Usability of the data, information and knowledge is dependent upon the fit between the psychological factors and the technology used. The psychological perspective is influenced by:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Skill mix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Experience with technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Health and Safety needs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Information Technology Construct
  - Technology Indicators
    - Ergonomics
    - Functionality
    - Amount
    - Characteristics
    - Work Flow
    - Rate of Flow
  - Information Indicators
    - Terminology
    - Flow
    - Format(s)
    - Amount
    - Accuracy
    - Security
    - Completeness
    - Access
    - Currency
<table>
<thead>
<tr>
<th>Technology (Hardware or Software)</th>
<th>Human Factors</th>
<th>MCCM Construct and Indicators</th>
</tr>
</thead>
</table>
| Technology systems are required that provide the ability to function in teams to achieve both individual and common goals. It is a test of affinity with human nature at the team level. Considerations include:  
  - Established lines of authority, communication patterns, and responsibilities 
  A team approach involves the ability to communicate and coordinate with each multidisciplinary team. This requires specified training for the technology that creates relationships that lead to tension or harmony. The discrete specialties in a mass casualty may have the need of very specific and distinct training | Team  
Team dynamics considers the need for the multidisciplinary team members to be able to see the actions of their colleagues with minimal effort so that respective actions can be coordinated even while busy with separate tasks. This involves creating a system tailored to the characteristics and needs of each of the multidisciplinary teams.  
The extraction teams may include search and rescue, fire, EMTs, Paramedics, and MDs while the decontamination teams may include fire, EMTs, Safety/Health | • Workforce Construct  
  – Indicators  
    ▪ Skill Mix  
    ▪ Training  
• Triage Unit  
Organizational Complexity Construct  
  – Indicators  
  – Number of Specialties/Size |
<table>
<thead>
<tr>
<th>Technology (Hardware or Software)</th>
<th>Human Factors</th>
<th>MCCM Construct and Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology systems are dependent upon:</td>
<td><strong>Organizational</strong></td>
<td>• Organizational Customs Construct</td>
</tr>
<tr>
<td>• Vision</td>
<td>Organizational factors strongly affect the operation of complex socio-technical systems.</td>
<td>– Indicators</td>
</tr>
<tr>
<td>• Leadership</td>
<td>Decisions at the organizational level can have a big impact on human behavior at lower levels. Organizational decisions should not be based solely on what is known about the physical world but must also take into account what is known about human nature.</td>
<td>▪ Shared beliefs</td>
</tr>
<tr>
<td>• Incentives/disincentives</td>
<td>The development of an incentive structure/work flow that empowers decision making at an organic level or supports a highly bureaucratic structure will determine the ability to control variance at its source and influence outcomes of care.</td>
<td>▪ Incentive Structure</td>
</tr>
<tr>
<td>• Information flow</td>
<td></td>
<td>▪ Leadership style</td>
</tr>
</tbody>
</table>

These are features of organizations not individuals. For example, the culture at the organizational level that is punitive related to errors or rather seeks information related to errors or near misses strongly influence the behavior of the workforce. Such factors as rewards, staffing, organizational level feedback, and the nature of the work follow influence outcomes.
<table>
<thead>
<tr>
<th>Technology (Hardware or Software)</th>
<th>Human Factors</th>
<th>MCCM Construct and Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political level functions include:</td>
<td><strong>Political</strong></td>
<td>This is not reflected in the model but involves the Office of Homeland Security policies, as well as laws, regulations and budgets developed at the Federal, State, Regional and Local levels.</td>
</tr>
<tr>
<td>• Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Budgets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Laws</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Regulations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policies provide a compass heading to orient the construction and operation of the system</td>
<td></td>
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</table>
Dear:

I am finishing my dissertation at the University of Arizona Tucson in the area of Informatics/Health Systems related to emergency preparedness.

My dissertation is titled “Validation of a Mass Casualty Model”. I am looking for experts in the area of emergency planning/response or emergency preparedness research to voluntarily participate on my panel of experts to validate a comprehensive model that I have developed. I am looking for experts like you to participate in a research study that uses an interdisciplinary continuity of care approach to provide a framework to study mass casualty events for the purpose of improving survivability and limiting disability. I will be using the Delphi Process to validate the model through Internet and email applications to structure all communications throughout this research. I sincerely hope that you might be interested in participating in this study. If you think you might be interested I will forward further information about the study and your responsibilities.

I sincerely hope that you might be able to help me with my research in this summer. I would be pleased to discuss this further and to forward additional information. It should only take 20-30 minutes of your time to complete each questionnaire.

I look forward to hearing from you,
Joan Culley

Joan M. Culley, MS, MPH, RN, CWOCN
Clinical Associate Professor of Nursing
School of Nursing
316 Arnold House
University of Massachusetts Amherst
715 North Pleasant Street
Amherst, MA 01003-9304
413 545 1737
jculley@nursing.umass.edu
APPENDIX C: DISCLAIMER FORM
Joan M. Culley, BSN, MS, MPH
Advisor: Judith Effken, PhD, RN, FACMI, FAAN
Nursing
P.O. Box 210203

BSC: B07.233  VALIDATION OF A MASS CASUALTY MODEL

Dear Joan Culley:

We received your research proposal as cited above. The procedures to be followed in this study pose no more than minimal risk to participating subjects and have been reviewed by the Institutional Review Board (IRB) through an Expedited Review procedure as cited in the regulations issued by the U.S. Department of Health and Human Services [45 CFR Part 46.110(b)(1)] based on their inclusion under research category 7. As this is not a treatment intervention study, the IRB has waived the statement of Alternative Treatments in the consent form as allowed by 45 CFR 46.116(d)(2). Although full Committee review is not required, the committee will be informed of the approval of this project. This project is approved with an expiration date of 28 June 2008. Please make copies of the attached IRB stamped consent documents to consent your subjects.

The Institutional Review Board (IRB) of the University of Arizona has a current Federalwide Assurance of compliance, FWA100004218, which is on file with the Department of Health and Human Services and covers this activity.

The IRB has waived consent as allowed by 45 CFR 46.116(d): (1) The research involves no more than minimal risk to the subjects; (2) The waiver or alternation will not adversely affect the rights and welfare of the subjects; (3) The research could not practically be carried out without the waiver or alternation; and, (4) Whenever appropriate, the subjects will be provided with additional pertinent information after participation.

Approval is granted with the understanding that no further changes or additions will be made to the procedures followed without the knowledge and approval of the Human Subjects Committee (IRB) and your College or Departmental Review Committee. Any research related physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

[Signature]

Theodore J. Glarke, Ph.D.
Chair, Social and Behavioral Sciences Human Subjects Committee

TJG/rdk

Cc: Departmental/College Review Committee
Validation of a Mass Casualty Model

I am a doctoral candidate conducting a research project titled "Validation of a Mass Casualty Model." You have been identified as an expert in the area of emergency planning/response or emergency preparedness research and you are being asked to voluntarily participate in this study.

The purpose of this study is to validate a proposed comprehensive conceptual model for mass casualty events. The multi-level model considers the information/technology needs of all multidisciplinary teams during a mass casualty event. The proposed model is based upon synthesized reviews of the literature and existing theoretical models. By responding to questions in online questionnaires, you will be giving your consent to participate in the study.

The research questions include:
1. To what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?
2. To what extent do experts agree that the proposed relationships among the constructs presented in the model provide valid representations of mass casualty triage?
3. To what extent do experts agree that the proposed indicators for each construct represent appropriate measurements for the constructs?
4. To what degree is the proposed model seen by experts as useful to the further study of information and technology requirements during mass casualty events?

The Delphi technique is being used to answer these four questions. This technique is a method for obtaining opinions from a panel of carefully selected experts who answer a series of questions over two or more rounds. Each round of questioning is followed with the anonymous feedback on the preceding round of replies. Computer, Internet connection that allows cookies and email applications will be used to structure all communications throughout this research. A webpage specifically designed for this study will be used to present each round of questions, and group responses to each round of questions, as well as to provide specific information about the Delphi process and the development of the proposed Mass Casualty Model. If you agree to participate you will be given the URL for the website.

If you agree to participate you will be committing to the completion of several questionnaires over the next six to eight weeks. It will take approximately 20-30 minutes to complete each questionnaire. After analysis of the responses a second questionnaire will be available on the website. The second questionnaire will include synthesized responses from the previous round to include: the median and frequencies to show the groups response to each question, subjective comments and the revised model if indicated through the responses. Additional rounds will be conducted in a similar manner until consensus is reached. Once consensus is reached the final analysis will be forwarded to you.

Your name will not be included on the questionnaires but a unique ID number available only to the PI will be assigned to each questionnaire. You will only be identified by this ID number. It is important that I be able to track the responses of each member of the group so that at the completion of the study I can better understand the perspectives of the participants.
according to geographical region, role in emergency preparedness, years of experience, etc. In order to maintain your confidentiality, your name will not be revealed in any reports, papers or other documents that result from this project. Your anonymity will also be protected from other panel members. Survey and questionnaire information will be locked in a cabinet in a secure place.

To participate in this study you must have the availability of a computer system that includes Internet access (cookies enabled) with sound capability and email access. If you are unable to participate or do not have the necessary computer capability I would appreciate your help in identifying at least one other individual who you think is an expert in emergency preparedness, response or research, that might be interested in participating in this survey.

If you agree to participate, within the next few days an email will be sent to you asking that you complete an online Panel Profile Survey. The results of this survey will determine the final experts selected to participate in this research. Only I will have access to your name. The four members of my dissertation committee and I will have access to the de-identified responses that you provide. There are no known risks from your participation and no direct benefit from your participation is expected. There is no cost to you except for the generous contribution of your time to improve triage outcomes during mass casualty events.

If you have any questions, I can be reached at 413-256-8786 days or evenings, or by email (jculley@nursing.umass.edu). If you have any questions concerning your rights as a research subject, you may call the Human Subjects Committee Office at the University of Arizona at 520-626-6721.

Please indicate you interest in participating in this study: Yes ☐ No ☐

If you are unable to participate could you please identify at least one other individual whom you think is an expert in the field of emergency preparedness that might be interested in participating in this survey:

Name: __________________________ Email: __________________________
Preferred phone number: __________________________

Please return this form to jculley@nursing.umass.edu to indicate whether or not you are interested in participating in this study.

Very respectfully,

Joan Culley

Joan M. Culley, PhD-c, RN, CWOCN, MS, MPH
University of Arizona
College of Nursing
Tucson, AZ
Home Phone: 413-256-8786
Email: jculley@nursing.umass.edu
APPENDIX D: PANEL PROFILE SURVEY
(As presented on-line through SurveyMonkey)
Thank you for your interest in participating in a study to validate a mass casualty comprehensive model. Approximately twenty experts will be selected to participate in the study based upon responses to the Panel Profile Survey. Please complete all questions. Select the best response that represents your experience and interest in mass casualty response, planning and/or research.

1. Name:

2. Gender:
   - Female
   - Male

3. Age:
   - 30-39
   - 40-49
   - 50-59
   - 60-69
   - 70 and over

4. Preferred email address:

5. Preferred telephone number:

6. Highest degree earned:

7. Professional Credential(s): (Check all that apply)
   - RN
   - MD
   - EMT/EMT-P/EMT-I
   - Other

8. If “Other” please specify credential(s):

9. Place of employment:
10. Title of your position related to emergency preparedness/response:


11. Briefly describe your work in emergency preparedness/response


12. Years employed in this position:


13. Which geographic zone best represents your area of employment related to emergency preparedness/response?

☐ Northeast  ☐ Southeast  ☐ North Central  ☐ South Central  ☐ Northwest  ☐ Southwest  ☐ Outside US Mainland

14. Which of following most clearly represents your area of responsibility related to emergency preparedness/response? (Check all that apply.)

☐ Local  ☐ Regional/County  ☐ State  ☐ Federal  ☐ Military  ☐ Non-governmental Organization  ☐ Research

15. Which of the following most clearly represents your area of specialization related to emergency preparedness/response? (Check all that apply.)

☐ Preparedness Planning  ☐ Emergency Response  ☐ Research in Emergency Preparedness/Response  ☐ Other

16. If "Other" please specify:


17. Do you have a computer system that includes Internet access with sound capability and email access?

☐ Yes  ☐ No

18. Will you have computer access so that you can participate in this study between July 1, 2007 and August 30, 2007?
19. Please rate your expertise in the area of emergency planning or response and/or research:

<table>
<thead>
<tr>
<th>Rate your Expertise</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</table>

20. Please indicate your willingness to participate in the study:

☐ Yes  ☐ No

Thank you for taking the time to complete the Panel Profile. Within the next week you will be notified by email of your selection status. Please contact me with any questions regarding your selection status, ability to participate or questions regarding the study.

Thank you for completing the Panel Profile Survey.
Very respectfully,
Joan Culley

Joan M. Culley, PhD-c, RN, CWOCN, MS, MPH
University of Arizona
College of Nursing
Tucson, AZ
Home Phone: 413-256-8786
Email: jculley@nursing.umass.edu
APPENDIX E: REVISED DISCLAIMER FORM
2 August 2007
Joan M. Cullay, BSN, MS, MPH
Advisor: Judith Eflkoe, PhD, RN, FACMI, FAAN
College of Nursing
PO Box 210203

RE: BSC 807.233 VALIDATION OF A MASS CASUALTY MODEL

Dear Ms. Cullay:

We received your amendment form dated 25 July 2007 and accompanying revised Consent form for the above referenced project. Permission is requested to:

- remove the requirement of anonymity of the panel of experts from other panel members [participants to be re-consented].

These changes do not impact subject safety. Approval of these changes is granted effective 2 August 2007.

The Human Subjects Committee (Institutional Review Board) of the University of Arizona has a current Federal Wide Assurance of compliance, number FWA0004218, which is on file with the Department of Health and Human Services and covers this activity.

Approval is granted with the understanding that no further changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research related physical or psychological harm to any subject must also be reported to each committee.

Sincerely yours,

Theodore J. Giattino, Ph.D.
Chair, Social and Behavioral Sciences Human Subjects Committee

TJG:md

cc: Departmental/College Review Committee
SUBJECT DISCLAIMER FORM

Validation of a Mass Casualty Model

I am a doctoral candidate conducting a research project titled "Validation of a Mass Casualty Model". You have been identified as an expert in the area of emergency planning/response or emergency preparedness research and you are being asked to voluntarily participate in this study.

The purpose of this study is to validate a proposed comprehensive conceptual model for mass casualty events. The multi-level model considers the information/technology needs of all multidisciplinary teams during a mass casualty event. The proposed model is based upon synthesized reviews of the literature and existing theoretical models. By responding to questions in online questionnaires, you will be giving your consent to participate in the study.

The research questions include:
1. To what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?
2. To what extent do experts agree that the proposed relationships among the constructs presented in the model provide valid representations of mass casualty triage?
3. To what extent do experts agree that the proposed indicators for each construct represent appropriate measurements for the constructs?
4. To what degree is the proposed model seen by experts as useful to the further study of information and technology requirements during mass casualty events?

The Delphi technique is being used to answer these four questions. This technique is a method for obtaining opinions from a panel of carefully selected experts who answer a series of questions over two or more rounds. Each round of questioning is followed with the anonymous feedback on the preceding round of replies. Computer, Internet connection that allows cookies and email applications will be used to structure all communications throughout this research. A webpage specifically designed for this study will be used to present each round of questions, and group responses to each round of questions, as well as to provide specific information about the Delphi process and the development of the proposed Mass Casualty Model.

If you agree to participate you will be committing to the completion of several questionnaires over the next six to eight weeks. It will take approximately 20-30 minutes to complete each questionnaire. After analysis of the responses a second questionnaire will be available on the website. The second questionnaire will include synthesized responses from the previous round to include: the median and frequencies to show the groups response to each question, subjective comments and the revised model if indicated
through the responses. Additional rounds will be conducted in a similar manner until consensus is reached. Once consensus is reached the final analysis will be forwarded to you.

A list of Panel Member names participating in this study will be available upon request but your anonymity will be protected during all other phases of the Delphi Process. Your responses on each questionnaire will be aggregated so that your identity will remain anonymous. Your name will not be included on the questionnaires but a unique ID number available only to the PI will be assigned to each questionnaire. You will only be identified by this ID number. It is important that I be able to track the responses of each member of the group so that at the completion of the study I can better understand the perspectives of the participants according to geographical region, role in emergency preparedness, years of experience, etc. Survey and questionnaire information will be locked in a cabinet in a secure place.

To participate in this study you must have the availability of a computer system that includes Internet access (cookies enabled) with sound capability and email access. If you are unable to participate or do not have the necessary computer capability I would appreciate your help in identifying at least one other individual who you think is an expert in emergency preparedness, response or research, that might be interested in participating in this survey.

If you agree to participate, within the next few days an email will be sent to you asking that you complete an online Panel Profile Survey. The results of this survey will determine the final experts selected to participate in this research. Only I will have access to your name. The four members of my dissertation committee and I will have access to the de-identified responses that you provide. There are no known risks from your participation and no direct benefit from your participation is expected. There is no cost to you except for the generous contribution of your time to improve triage outcomes during mass casualty events.

If you have any questions, I can be reached at 413-256-8786 days or evenings, or by email (juleyl@nursing.umass.edu). If you have any questions concerning your rights as a research subject, you may call the Human Subjects Committee Office at the University of Arizona at 520-626-6721.

Please indicate you interest in participating in this study:  Yes ☐  No ☐

If you are unable to participate could you please identify at least one other individual whom you think is an expert in the field of emergency preparedness that might be interested in participating in this survey:

Name: __________________________ Email: __________________________ or
Preferred phone number: __________________________

Version July 25, 2007
Please return this form to jculley@nursing.umass.edu to indicate whether or not you are interested in participating in this study.

Very respectfully,
Joan Culley

Joan M. Culley, PhD-e, RN, CWOCN, MS, MPH
University of Arizona
College of Nursing
Tucson, AZ
Home Phone: 413-256-8786
Email: jculley@nursing.umass.edu

Version July 25, 2007
APPENDIX F: EMAIL DIRECTING PANEL MEMBERS TO STUDY WEB PAGE
Congratulations, you have been selected to participate on the panel of experts to validate a Mass Casualty Model. Within the next week please visit the following website that was developed to assist you in understanding the purpose of this study.

By July 30th I ask that you visit the following website (www.u.arizona.edu/~jculley). No password is required. Please review the following links:

- The five minute narrated presentation titled “NARRATED PRESENTATION-DELPHI PROCESS” explains the Delphi Process and provides useful instructions to guide you through the Delphi Process.
- The twenty minute narrated presentation titled “NARRATED PRESENTATION-EXPLANATION OF THE MCCM” provides an overview of the model that you will use to answer a series of questions during each round of the Delphi Process.
- A link to COPY OF THE MASS CASUALTY CONCEPTUAL MODEL provides a pictorial representation of the model and figures with the suggested measures for each of the concepts. I suggest that you print the model for use as a reference as you move through the questions in the Delphi Process.
- A link to GLOSSARY OF TERMS FOR THE MASS CASUALTY CONCEPTUAL MODEL. I also suggest that you print the glossary for use as a reference as you answer each question in the Delphi Process.
- The link titled ROUND ONE FEEDBACK and ROUND TWO FEEDBACK will be available two weeks after the close of each round of the Delphi Process questionnaires.
- There is also a link to the approved Institutional Review Board (IRB) form from the University of Arizona for your review.

I intentionally designed the study to keep tight time frames. You will be given one week to review this website. On Monday, July 30th the first round questionnaire link from SurveyMonkey will be emailed to you. You will then have one week to complete the questionnaire. You will be notified by email within two weeks of the close of round one that the feedback from round one is available on the website for your review. The second round questionnaire will then be emailed.

Thank you for your valuable time. Please contact me with any questions.

Very Respectfully,
Joan Culley
MASS CASUALTY CONCEPTUAL MODEL (MCCM)® WEBSITE
Joan M. Cusay, RN, CWOCN, MS, MPH
Ph.D. Candidate
College of Nursing
University of Arizona Tucson

This website has been developed to support research related to the validation of the Mass Casualty Conceptual Model (MCCM)®

Events such as hurricane disasters, terrorist and the 2001 attacks on the World Trade Center and Pentagon definitely illustrate the multiplicity of current disaster population systems. The national response to such incidents represents one of the greatest challenges to our nation’s emergency response infrastructure. The purpose of this research is to provide a comprehensive conceptual model for mass casualty events.

Contact Information
Joan Cusay
Email: Joan.Cusay@u.arizona.edu
Phone: (520) 626-8788

Narrative Presentation of the Delphi Technique
Five junior nursing professionals and their supervisors participated in this research study. Computer with speakers needed to listen to this presentation.

Narrative Explanation of the MCCM
Twenty junior nursing professionals and their supervisors participated in this research study. Computer with speakers needed to listen to this presentation.

Copy of the Mass Casualty Conceptual Model
Please print a copy of the model.

Copy of Glossary of Terms
Please print a copy of the model.

Round One Feedback
Feedback will be uploaded within two weeks of the close of the online Round One Questionnaire.

Round Two Feedback
Feedback will be uploaded within two weeks of the close of the online Round Two Questionnaire.

Copyright
The concepts developed for this research is the intellectual property of Joan M. Cusay. All rights reserved. No part of this work may be reproduced in any form or by any means, graphic, electronic, or mechanical, including photocopying, taping, or information storage or retrieval systems—without prior written consent.

University of Arizona Tucson Human Subjects Website

The University of Arizona.
APPENDIX H: NARRATED PRESENTATION-DELPHI PROCESS
INTRODUCTION TO THE DELPHI PROCESS AND PANELISTS RESPONSIBILITIES IN THIS STUDY
Joan Culley, MS, MPH, RN, CWOCN
Doctoral Candidate
University of Arizona Tucson

Audio Script
- This is a brief presentation that describes:
- Your responsibilities as an expert panel member
- The Delphi Process

DELPHI TECHNIQUE
- The Delphi technique is a method for obtaining opinions from a panel of carefully selected experts who answer a series of questions over two or more rounds
- Each round of questioning is followed with the anonymous feedback on the preceding round of replies
- Thus, the experts are encouraged to revise their earlier answers in light of the replies of other members of the group

Audio Script
- You will be presented with specific questions that relate to each component of the proposed Mass Casualty Conceptual Model referred to in this study at the “MCCM”.
- The questions are designed to solicit your opinion on the importance of each component of the model to the understanding of mass casualty events. This is explained in depth in the next narrated presentation titled “Explanation of the “MCCM”.
- At the completion of each round, responses will be summarized, made anonymous, and two weeks later the responses will be made available to all panelists on this web site.
- Median or the middle responses, that divide the distribution of scores in half, will be presented to the group with a depiction of the range of responses for each question as well as any written responses to questions.
- Please print a copy of your questionnaire so that you may compare your responses to those of the group.
- Presentation of group responses to each question provides feedback about how panelists answered questions in relation to other panel
<table>
<thead>
<tr>
<th>Slide 3</th>
<th>DELPHI TECHNIQUE</th>
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<tbody>
<tr>
<td></td>
<td>Twelve to fifteen experts have been selected to participate.</td>
</tr>
<tr>
<td></td>
<td>Rounds of questions continue until consensus of each component of the model is reached.</td>
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</tbody>
</table>

**Audio Script**
- Twelve to fifteen experts have been selected based upon the information provided in the Panel Profile Survey.
- The expert panel was selected based on a high level of expertise in the areas emergency preparedness planning, response or research and representation from local, regional/county, state, federal/military and research communities.
- Consensus is reached when a majority of the panelists agree on each component of the model.
- After each round of questions responses are used to revise the model and to present a next round of questions.
- Questions regarding components of the model that have already been agreed upon by a majority of the panel will not appear in future rounds of questions.
- Succeeding rounds will only include questions that have not reached consensus, this means shorter questionnaires.
- Each succeeding round should take less of your valuable time!

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<table>
<thead>
<tr>
<th>Slide 4</th>
<th>ONLINE QUESTIONAIRE INSTRUCTIONS</th>
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<tbody>
<tr>
<td></td>
<td>Online questionnaires are constructed through a custom survey software program called SurveyMonkey that is available: 1) design the surveys, 2) collect responses, and 3) analyze results. SurveyMonkey provides a secure computer environment. Each panel member is known only by a unique ID number assigned by SurveyMonkey. Panelists can resume the questionnaire where you leave off: You may leave the survey and then return later. SurveyMonkey will save your progress and remember which questions you have completed. Each panel member is asked to use the same computer to resume. The next page is determined where panelists leave off based on the last completed page. All panelists click the “next” button in the survey, the survey page closed. There is a time limit to complete the survey the time limit for each task: 30 minutes. The survey link reminds where panelists leave off based on the last completed page. The survey link reminds where panelists leave off based on the last completed page. In order for the survey not to remember the last question completed.</td>
</tr>
</tbody>
</table>

**Audio Script**
Same as slide
### Slide 5

**ONLINE QUESTIONNAIRE INSTRUCTIONS**

- Panelists will be notified by email when each round of questions are available online.
- A hyperlink in the email will take panelists directly to the questionnaire.
- Questionnaires are available online for one week then closed to further activity.

### Audio Script

**Same as slide**

- You will need your password to enter the web site. If you forget your password please contact me (jculley@nursing.umass.edu) and I will forward your password.

### Slide 6

**ONLINE QUESTIONNAIRE INSTRUCTIONS**

- Please print a copy of the model and the seven figures that show the indicators for each model to serve as a reference as you move through each question on the questionnaire.
- Please print a copy of the glossary of terms to serve as a reference as you move through each question on the questionnaire.

### Audio Script

**Same as slide**

- I suggest that panelists print a copy of the model and the seven figures that show the indicators for each model.
- The model and figures are available on the website under the link titled “MCCM”. Please click on this link to copy the model and figures.
- You may then use these figures to serve as a reference as you answer each question on the questionnaire.
- I suggest that you also print a copy of the glossary of terms. The glossary is available on the website under the link titled “Glossary”. Please click on this link to copy the glossary of terms. You may also use this to serve as a reference as you answer each question.

### Slide 7

**COMMITMENT**

- Each round of questions should take between 20-30 minutes to complete.
- Two to three rounds of questions are expected however it may take more if consensus is not reached regarding each component of the model.
- Three rounds of questions should be completed within eight weeks of the beginning of the study.

### Audio Script

**Same as slide**

- The proposed model is complex and panelists may not be familiar with the vocabulary used in this model. I suggest that panelists print a copy of the model and the seven figures that show the indicators for each model.
- The model and figures are available on the website under the link titled “MCCM”. Please click on this link to copy the model and figures.
- You may then use these figures to serve as a reference as you answer each question on the questionnaire.
- I suggest that you also print a copy of the glossary of terms. The glossary is available on the website under the link titled “Glossary”. Please click on this link to copy the glossary of terms. You may also use this to serve as a reference as you answer each question.
Should you have questions concerning your rights as a research subject, you may call the Human Subjects Committee Office at the University of Arizona at 520-626-6721 or link to their website (link is available on this website under "Human Subjects").

Should you have questions concerning your participation in this study please contact me at:

- Phone: 413-556-8786
- Email: jculley@nursing.umass.edu
APPENDIX I: NARRATED PRESENTATION-EXPLANATION OF THE MCCM
# NARRATED PRESENTATION – EXPLANATION OF THE MCCM MODEL

<table>
<thead>
<tr>
<th>Slide 1</th>
<th>Audio Script</th>
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<tbody>
<tr>
<td><img src="" alt="Validation of a Mass Casualty Conceptual Model (MCCM&lt;sup&gt;©&lt;/sup&gt;)" /></td>
<td></td>
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<tr>
<td>Thank you for agreeing to participate in this research. The following slides and narrated presentation provide an overview of the proposed model that you will use to answer questions during a series of Delphi rounds to validate this model. The model is a pictorial representation of all of the complex factors or conditions that influence patients and the judicious use of resources during a mass casualty event.</td>
<td></td>
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<tr>
<th>Slide 2</th>
<th>Audio Script</th>
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<tbody>
<tr>
<td><img src="()" alt="The Problem - Natural or Manmade Disasters Produce Casualties" /></td>
<td></td>
</tr>
<tr>
<td>This research relates to the factors or variables that make a difference between life and death or disability for victims of natural or man-made disasters that produce more than six causalities. What is it about disasters that make a difference between life and death or disability? I believe the answer to this question involves a very complex series of events and contextual factors or conditions that influence the way we respond to disasters. The purpose of this research is to identify the major concepts that influence outcomes and the indicators that can be used to measure these concepts for the purpose of increasing survivability and reducing disability given the limited resources that occur in any major disaster.</td>
<td></td>
</tr>
</tbody>
</table>
WHAT IS IT ABOUT DISASTERS THAT MAKES THE DIFFERENCE BETWEEN LIFE AND DEATH?

- Patients
- Workforce
- Resources
- Environment
- Organizational Complexity
- Information
- Technology

Audio Script
Major concepts (known as constructs in the model) are proposed to answer the following types of questions:

- How do the type, number of injuries, demographics and variability of the victims or patients impact outcomes?
- How do the skill mix, knowledge, experience, credentials, training, education and health and safety needs of the workforce influence outcomes?
- How do the amount, location and types of resources influence the outcomes?
- What is it about the environmental conditions such as the geographic size, duration, type of man-made or natural disaster, warning system, and rural or urban setting that make a difference?
- Do the number of workforce specialties involved in a casualty, the size of the organization, the utilization of high tech methods and the culture that exists within a triage team affect the manner in which the work is structured?
- How do the characteristics, flow, terminology and security of information impact decisions at the point of care and throughout the organization?
- What types of technology work best in mass casualty environments to provide information at the right time to the end user?
- How does this information disseminated through technology impact the flow of the work, and decision support to provide good triage decisions and care?

And how do all of these come together to produce the greatest survivability within a resource constrained environment?
SIGNIFICANCE
There is currently no established theoretical framework or “gold standard” for evaluating the effectiveness or efficacy of information decision support systems or triage systems that can be used in mass casualty events.

SIGNIFICANCE OF THE MCCM
- Offers a more comprehensive view of mass casualty events
- Moves science forward in the area of emergency preparedness
- Has the potential to maximizes survival rates

Audio Script
Same as slide
RESEARCH QUESTIONS

- To what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?
- To what extent do experts agree that the proposed variables and relationships among the variables presented in the model provide valid representations of mass casualty triage?

Audio Script

The purpose of this research is to propose a comprehensive conceptual model for mass casualty events. The first step in this process is to validate this model (or pictorial representation) using your expert options. Your answers to each round in the Delphi process are structured to answer the following research questions:

- To what extent do experts agree that the constructs in the proposed model represent appropriate predictors of outcomes of care during mass casualty events?
- To what extent do experts agree that the proposed relationships among the constructs presented in the model provide valid representations of mass casualty triage?

RESEARCH QUESTIONS

- To what extent do experts agree that the proposed indicators for each construct represent appropriate measurements for the constructs?
- To what degree is the proposed model seen by experts as useful to the further study of information and technology requirements during mass casualty events?
The MCCM has been derived from:
- Two systems theories:
  - Structural Contingency Theory
  - Technology Theory
- One informatics models:
  - Vicente’s Human-Tech Ladder Model

The MCCM considers the information/technology needs from the perspective of all multidisciplinary teams that respond to any type of a mass casualty event. To help better understand the influences of all of the complex factors that interact during a mass casualty event, I use two systems theories and one human factors model on which to identify or name the:
- Major conditions or constructs that define any mass casualty event;
- Relationships that exist among these constructs. Some constructs precede or influence others in the model; and
- The indicators that can be used to measure each of these constructs once the model is actually tested.

Print a copy of the model and figures on the next seven slides to serve as a resource when answering questions during each round of the Delphi process.

Print a copy of the Glossary for use in understanding the terminology used in the research.

This is a pictorial representation of the Mass Casualty Conceptual Model (or MCCM) that you will use to answer a series of questions during each round of the Delphi Technique. The ovals represent the constructs or conditions that identify the major components in any mass casualty event. The arrows represent the relationships among the constructs. Arrows indicate the influence of certain constructs on other constructs.
### The Emergency Operation Center Level

The Emergency Operation Center Level represents the highest hierarchical level in this organizational structure. The construct labeled “Organization Customs” represents all of the data that will be collected at the Emergency Operational Center Level to include such factors as shared beliefs about prioritization and leadership style. The Triage Level represents the level in any mass casualty event where triage decisions are made. All data included in the Triage Level constructs will be collected at each of the triage units. The number of triage units varies depending upon the size, duration and type of disaster.

The model is arranged in five stages:

- **Stage I: Contextual Environment** – or conditions (constructs) that directly influence the Information Environment;
- **Stage II: Information Environment** – or condition (construct) that includes information/technology;
- **Stage III: Structural Environment** – or condition (construct) that considers the dynamic nature of the organizational structure;
- **Stage IV: Triage** – or condition (construct) that includes the processes used to treat patients; and
- **Stage V: Goals** – or condition (construct) that includes both patients and resources.

I believe that the nature of mass casualty events requires an organizational structure (see the Glossary on the website for a more complete description of each construct and indicator):

- That is shaped by the beliefs, leadership style, and the incentive structure at the Emergency Operation...
Center Level on the prioritization criteria of victims for care (Organizational Customs);
• That is scaled to meet the demands of an event by the culture, size of the workforce, degree of technology used and specialties involved (Triage Unit Organizational Complexity);
• That is defined by the type of disaster (Environmental Context);
• That is related to the specific characteristics of each (Patient) or victim in an incident;
• That must be able to efficiently use the amount, type and location of (Resources) that are available;
• That brings together a wide skill mix of individuals (Workforce) who may never have worked together before; and that all of these constructs or conditions are needed
• To develop and information and technology infrastructure needed to support this entire process (Information/Technology).
• The (Structure) that best fits all of these conditions or constructs is influenced by Information/Technology and likewise Structure influences Information/Technology needed to
• Develop an appropriate process of classifying and prioritizing victims according to predetermined severity algorithms (Triage);
• To ensure the greatest survivability with a context of limited resources (Outcomes).

You will be asked during the Delphi rounds to determine how important each of these proposed constructs and relationships are to the understanding of mass casualty triage events.
The next seven slides are pictorial representations of each of the five stages of the model. The slides indicate proposed indicators or measures for each of the constructs. The Glossary on the website provides more detailed definitions for each indicator and construct.

You will be asked during the Delphi rounds to accept, reject or change any of these indicators.

Stage I (Contextual Environment) depicts the influence of six constructs on the Information Environment. Stage I is the largest stage in the model and is depicted over the next three slides.

Stage I constructs include:

- **Organizational Customs.** Indicators or measures of this construct include:
  - Shared beliefs about the prioritization of patients for treatment (or which patients should be treated first or which should not be treated due to the emergent nature of their injuries and limited resources available to treat multiple patients);
  - The life cycle or growth and stability of the structure for a particular event;
  - Incentive structure or the punishment/reward system and feedback provided to the workforce; and
  - The leadership style of the personnel at the Emergency Operation Center Level or the highest hierarchical level in this organizational structure.

- **Triage Unit Organization Complexity.** Indicators or measures of this construct include:
The Environmental Context construct includes the following indicators or measures:

- The nature of the disaster or whether the disaster is related to natural causes such as:
  - Hurricanes
  - Floods
  - Tornadoes
  - Snow/Ice storms
  - Power losses
- Or from man-made causes such as:
  - Chemical releases or spills
  - Radiological releases or spills
  - Biological releases or events
  - Explosive events
- The geographic size of the event
- The duration of the event in hours, days, weeks, etc.
- The use of warning systems
- The setting be it a rural, urban or a
Audio Script
This slide depicts the forth, fifth and sixth constructs at Stage I or the Contextual Environmental of the model.

- The **Patients** construct includes the following indicators or measures:
  - The number and type of injury(ies)
  - Demographics such as age, gender, or other contributing medical conditions
  - Variability in the patients or exceptional cases that determine whether the patient(s) can be treated in a standardized fashion without continual adjustment

- The **Resources** construct includes the following indicators or measures:
  - Categories of resources needed
  - Amount needed
  - Location of each recourse

- The **Workforce** construct includes the following indicators or measures:
  - Credentials and licenses of all workforce members
  - Experience in mass casualty events
  - Experience with medical and information technology
  - Training in mass casualty triage

combination of both settings.
Stage II, or the Information Environment depicts the influence of the six previous constructs on the way in which information is processed and technology selected for use. The characteristics of this construct directly influence the fit of information and technology to each Triage Level Structure. The **Information Technology construct** in this stage includes indicators or measures for both Technology and Information.

- **Technology** includes the following indicators or measures:
  - Characteristics such as the ergonomics, functionality and amount of technology used in each unit of triage
  - Work flow and
  - Rate of information

- **Information** includes the following indicators and measures:
  - Terminology used by all multidisciplinary members and whether or not it is standardized and interferes with or enhances information flow and processing
- Flow of information from the Emergency Operation Center Level to triage units, from triage unit to triage unit and from triage units to the Emergency Operation Center Level
- Security of the information related to HIPAA and to encryption for transmission as well as to security needed at the triage levels of care
- Characteristics of the information related to such factors as:
  - Format(s)
  - Amount
  - Accuracy
  - Usability
  - Completeness

**Slide 15**

**Mass Casualty Triage Conceptual Model**

**Stage III: Structural Environment**

**Stage III or Structural Environment** relates to the type of structure needed at the Triage Level.

Information Technology directly influences the type of structure needed at each Triage level and structure in turn influences Information Technology.

The **Stage III Structure** construct includes the following indicators or measures:

- Work flow variability or the dynamic changes in patient conditions that may necessitate adjustments in triage classification
- Search behaviors or the degree to which judgment, experience or intuition must be used by the workforce to make triage decisions
- Structure or the dynamic organizational framework from hierarchical to flexible needed to make triage decisions. Measures of structure include spatial integration or the horizontal and vertical lines of communication and feedback loops used to make triage decisions.

**Audio Script**

Stage III or Structural Environment relates to the type of structure needed at the Triage Level. Information Technology directly influences the type of structure needed at each Triage level and structure in turn influences Information Technology.

The Stage III Structure construct includes the following indicators or measures:

- Work flow variability or the dynamic changes in patient conditions that may necessitate adjustments in triage classification
- Search behaviors or the degree to which judgment, experience or intuition must be used by the workforce to make triage decisions
- Structure or the dynamic organizational framework from hierarchical to flexible needed to make triage decisions. Measures of structure include spatial integration or the horizontal and vertical lines of communication and feedback loops used to make triage decisions.
Stage IV or **Triage** relates to the care delivered to patients at each triage unit whether it be in the field at the point of injury, at a Disaster Medical Assistance Team (DMAT) portable facility or in an emergency room. The **Triage** construct includes the following indicators or measures:

- Time it take to triage each patient
- Classification category assigned to each patient
- Prioritization for treatment assigned to each patient.

Stage V or **Goals** relates to both patients and resources. The numbers of lives saved and deformities prevented by the appropriate use of resources is a measure of the efficiency and appropriateness of the structure and processes of the organizational system. The **Outcomes** construct includes the following indicators or measures:

- Patient Outcomes or the numbers of patients that survive or who are disabled by their injuries
- Resource Outcomes related to:
  - Overtriage – or the overestimate of patient injuries that inappropriately uses limited resources at the potential expense of patient with more severe injuries
  - Undertriage – or the assignment of critically injured patients needing immediate care to a delayed category that can lead to preventable deaths or deformities.
QUESTIONS?

- Should you have questions concerning your participation in this study please contact me at:
  - Phone: 413-256-8786
  - Email: jculley@nursing.umass.edu

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The model developed for this research is the intellectual property of Joan M. Culley. All rights reserved. No part of this work may be reproduced in any form or by any means – graphic, electronic, or mechanical, including photocopying, taping, or information storage or retrieval systems – without prior written consent.
APPENDIX J: GLOSSARY OF TERMS RELATED TO THE MCCM
GLOSSARY OF TERMS
FOR THE MASS CASUALTY CONCEPTUAL MODEL©

Italics and crossed out words represent modifications to the original
glossary based on the data analysis from the Delphi process

CONSTRUCTS:
Each of the constructs proposed in the model is defined below:

Organizational Customs: Leadership style, incentive structure and beliefs about the prioritization criteria of victims for care, by the Emergency Operation Center Level based upon the life cycle of an all hazards event that relates to the stability including the financial assists available to the organization and growth of the organizational structure to handle the event. The Emergency Operational Center Level sets the priorities for all triage units. These customs determine the ability to scale a response to handle the size and complexity of an event or the need to expand the structure to include regional, state or federal resources. Disaster Planning has a critical impact on outcomes.

Triage Unit Organizational Complexity: Culture, size of the workforce, degree of technology used and specialties skill mix required to meet the demands of an event at the triage level of care. Complexity is dependent upon the number of specialties required to deal with victims, contain any chemical or biological release, secure the scene, protect potential evidence, protect the public and workforce from exposure to dangerous chemicals, biologicals and structures, secure resources, etc. Complexity is a measure of such variables as: the size of the workforce required to accomplish all of these tasks; the use of customary or unfamiliar technology in the extrication, decontamination, assessment and treatment of the victims; the number of procedures used on each victim from extrication to treatment; and the culture within the workgroup that relates to their relationships with one another and their perceptions of their ability to control their work.

Environmental Context: Nature and contextual influences of a disaster that include: size of the immediate damaged area as well as surrounding areas affected by a disaster; duration of the event from the time of notification of an impending event or the first signs or symptoms of a problem to the definitive treatment of victims and workforce related injuries; and the rural or urban setting proximity to the disaster and distance to health facilities that influence the numbers of potential victims and resources.

Patients: Victims in a mass casualty incident. This includes variables related to: the number of victims; the types and number of injuries; the age, gender, or other contributing medical health conditions that influence survivability; and the variability created by multiple injuries that requires significant judgment related to classification and prioritization for treatment.
**Resources:** The categories, amount and location of all resources needed to respond to an incident. These include not only medical health care supplies and personal protective equipment but all logistical equipment and supplies needed to feed, supply and support the workforce, the equipment needed for rescue and recovery, equipment needed for environmental surveillance and monitoring, etc.

**Workforce:** The wide variety of personnel responding to an incident that might include firefighters, police, EMTs, Paramedics, RNs, MDs, industrial hygienists, public health personnel, etc. The nature of the workforce includes: experience with mass casualty injuries; experience in dealing with the technology used to assess, decontaminate, and treat victims; the skill mix of the workforce treating the victims; the education of the workforce that might make a difference in their ability to use independent judgments regarding classification and treatment; and their needs related to safety and health, their willingness to work in times of mass casualty events and their physical health.

**Information Technology:** The use of electronic, paper or other methods to convert, store, protect, process, transmit and retrieve information, securely. Data transformed into information through the appropriate use of technology provides the infrastructure for a mass casualty event.

- **Technology:** relates to the type and nature of the methods used to provide visibility and processing of data to track patients, the workforce, resources, and environmental factors. This involves the use of technology such as personal data assistant (PDA) devices as well as paper and pencil triage tags used to provide point of care decision resources and assessment documentation but also communication technology to transmit data real-time for decision support.

- **Information:** relates to the nature of the data that is accessed processed and disseminated in a way that provides accurate, complete, and secure information to authorized users in the proper amount, language and format.

**Structure:** The type of organizational framework needed by each triage unit (from hierarchical to flexible) to support the needs of the workforce in managing the diverse needs of each patient.

**Triage:** The process of classifying and prioritizing victims according to predetermined severity algorithms to ensure the greatest survivability with a context of limited resources during the acute phase to definitive treatment for each patient.

**Outcomes:** Goals related to both patients and resource. The numbers of lives saved and deformities prevented by the appropriate use of resources. Also includes safety precautions that includes the use of personal protective equipment and safety devices when appropriate to prevent workforce and patient injuries.
INDICATORS OR MEASURES FOR EACH CONSTRUCT:

Each of the indicators or measures for each construct is defined below:

**Organizational Customs Indicators:**

- **Shared beliefs**: Views about the prioritization of patients for treatment related to which patients should be treated first or which patients should not be treated due to the emergent nature of their injuries and limited resources available to treat multiple patients.

- **Life cycle**: Growth and stability of the structure for a particular event. The ability of the organization at the Emergency Operation Center Level to handle the size and complexity of an event or the need to expand the structure to include regional, state or federal resources.

- **Incentive structure**: The punishment/reward system and feedback provided to the workforce.

- **Disaster Planning**: Relates to prior preparation related to resources, workforce, mutual aide agreements and experience with prior events.

- **The leadership style**: The manner and approach of providing direction, implementing plans, and motivating people at the Emergency Operation Center Level or the highest hierarchical level in the organizational structure.

**Triage Unit Organizational Complexity Indicators:**

- **Number of Specialties**: The types of roles, numbers and relevance of the specialties involved by the workforce at the triage level.

- **Size**: The number of workforce members and numbers of patients seen at each triage unit.

- **Technology Readiness**: The ability at the triage level to handle technology.

- **High Tech**: The use of customary or unfamiliar treatments conducted at the triage level.

- **Team Culture**: The ability to self regulate work through delegation of tasks, identification of communication priorities and monitoring of activities through relationships or team work employed in each triage unit. The quality, frequency and standards used in exercises and drills contribute to team culture and success.
**Environmental Context Indicators:**

- **Nature of a Disaster**: The type of the disaster related to natural, unintended or deliberate causes.
  
  Causes include:
  - Fires
  - Volcanoes
  - Hurricanes
  - Flood or slides
  - Tornadoes
  - Extreme temperature events such as Snow/Ice storms or extreme heat
  - Power losses
  - Chemical releases or spills
  - Radiological releases or spills
  - Biological releases or events
  - Explosive events

- **Size**: The geographic extent of the immediate damaged area as well as surrounding areas affected by a disaster. *This can occur at the state, regional, national or international level.*

- **Duration**: The length of the event in hours, days, weeks, etc. from the time of notification of an impending event or the first signs or symptoms of a problem to the definitive treatment of victims and workforce related injuries.

- **Warning Systems**: The use of notification methods to alert communities and emergency response organizations of impending problems or concerns.

- **Setting**: *The proximity to the disaster and distance to health care facilities.*
  - rural, suburban or urban location of an event that influences the numbers of potential victims and resources.

- **Competing Disasters**: *Opposing disasters in the same state or area affect resources and outcomes.*

**Patients Indicators:**

- **Injury Type and Number**: The types and numbers of wounds or other trauma related to each patient.

- **Demographics**: Age, gender, or other contributing medical health care conditions related to patients that influence survivability.

- **Variability**: (Exceptional Cases): Unpredictability created by multiple or unfamiliar injuries that require significant judgment related to classification and prioritization for treatment.

**Resources Indicators:**

- **Categories**: Classifications of assets needed to adequately treat patients. These include not only medical health care supplies and personal protective equipment but all logistical equipment and supplies needed to feed, supply...
and support the workforce, the equipment needed for rescue and recovery, and equipment needed for environmental surveillance and monitoring, etc.

- **Amount Availability:** The number of assets and supplies accessible to adequately treat patients 24/7 for the duration of the incident.

- **Location:** The position or place where assets and supplies can be located and mobilized if needed.

**Workforce Indicators:**

- **Credentials/Licenses:** The qualifications of each member of the workforce and the ability to keep up-to-date records of current certifications.

- **Experience:** Familiarity with methods used to assess, decontaminate, and treat victims.

- **Experience with Technology:** Practice and familiarity in dealing with various electronic, paper or other methods needed to convert, store, protect, process, transmit and retrieve information, securely.

- **Training:** Preparation and practice to update and maintain skills related to the treatments of patients of mass casualty events.

- **Skill mix:** The composition of the workforce with various types of Credentials/Licenses and experiences required to adequately care for patients during a mass casualty event. *This includes the identification of cross trained members of the workforce in more than one role.*

- **Education:** The various types of instruction obtained by the workforce that provides the ability to use independent judgments regarding the classification and treatment of patients during a mass casualty event.

- **Needs related to health and safety Willingness to work:** relates to concerns for health and safety for self and family as well as fear and concern for pets, etc.

- **Age:** The maturity of the members of the workforce that may influence their ability to handle mass casualty events.
**Information Technology Indicators:**

- **Technology Variable (Hard and Soft):** Relates to the type and nature of the methods used to provide visibility and processing of data to track patients, the workforce, resources, and environmental factors. This involves the use of technology such as personal data assistant (PDA) devices as well as paper and pencil triage tags used to provide point of care decision resources and assessment documentation but also communication technology to transmit data real-time for decision support.
  - **Characteristics:** Ergonomics and functionality of the technology and the amount of technology used in each unit of triage that helps to answer the question ‘is the technology appropriate for the specific setting?’
  - **Work Flow:** The channels used to move tasks through a work process.
  - **Rate of Flow:** The speed with which tasks or documents move through a work process.
  - **Redundancy:** The back-up systems in place if one system fails.
  - **Access to Power:** The energy sources needed to support technology.
  - **Connectivity:** The ability to access the Internet, servers and other computer applications.

- **Information Variable:** Relates to the nature of the data that is accessed, processed and disseminated in a way that provides accurate, complete, and secure information to authorized users in the proper amount, language and format.
  - **Terminology:** The vocabulary and terms used by all multidisciplinary members and whether or not it is standardized and interferes with or enhances information flow and processing.
  - **Flow:** The speed with which data and information move from the Emergency Operation Center Level to triage units, from triage unit to triage unit and from triage units to the Emergency Operation Center Level.
  - **Security:** Protection of information related to Health Insurance Portability and Accountability Act (HIPAA), encryption for transmission and protection from possible terrorists. inappropriate uses by unauthorized users. This includes the security of servers and the provision of redundant systems.
  - **Characteristics:** The quality of the information related to such factors as:
    - Format(s)
    - Amount
    - Accuracy
    - Usability
    - Completteness
    - Access
• Currency

**Structure Indicators:**
- **Work flow Variability:** Dynamic changes in patient conditions that may necessitate adjustments in triage classification.
- **Search Behaviors:** The degree to which judgment, experience or intuition must be used by the workforce to make triage decisions.
- **Structure:** The dynamic organizational framework from hierarchical to flexible needed to make triage decisions. Measures of structure include spatial integration or the horizontal and vertical lines of communication and feedback loops used to make triage decisions.

**Triage Indicators:**
- **Time to Triage:** The period from first encountering a patient to assessing the patient, assigning a triage classification and providing *acute* definitive treatment for each patient.
- **Classification:** The sorting of patients into categories by first responders according to the immediate need for *medical* health care attention. Traditionally a color-coded tag is used to denote a patient’s condition and to make them easily recognizable.
- **Prioritization:** Decisions regarding which classification of patients will receive treatment when there is an imbalance between needs and supplies and it is not possible to provide care for all of the victims. When the magnitude of the event places a demand on resources that outmatches the capabilities of the workforce, medical health care is delivered to victims based on the severity of their injury and need.

**Outcomes Indicators:**
- **Patient Outcome Variable:** The numbers of patients that survive or who are disabled by their injuries.
- **Resource Outcomes:** The primary goal of triage is to identify the optimal resources required to adequately and efficiently treat a patient. The optimum use of resources can be measured by determining:
  - Overtriage: or which patients’ injuries were overestimated that inappropriately used limited resources at the potential expense of patients with more severe injuries.
  - Undertriage: or critically injured patients needing immediate care that were prioritized to a delayed category that can lead to preventable deaths or deformities.
- **Safety:** *The appropriate use of personal protective equipment and safety devices as appropriate to reduce worker and patient injuries.*
STAGES IN THE MASS CASUALTY CONCEPTUAL MODEL:
Each stage of the proposed model is defined below:

**Stage I: Contextual Environment:** The conditions (constructs) that directly influence the Information Environment. Includes the following constructs that describe the background that impacts a mass casualty event:
- Organizational Customs
- Triage Unit Organization Complexity
- Environmental Context
- Patients
- Resources
- Workforce

**Stage II: Information Environment:** Includes the Information Technology construct that describes the conditions that influence technology and information needs during a mass casualty event.

**Stage III: Structural Environment:** Includes the Structure construct that describes the dynamic nature of the organizational structure.

**Stage IV: Triage:** Includes the Triage construct that describes the processes used to treat patients.

**Stage V: Goals:** Includes the Outcomes construct that describes the outcomes related to both patients and resources and safety.
APPENDIX K: FIRST ROUND QUESTIONNAIRE
(As presented on-line through SurveyMonkey)
Welcome to the first round of questions related to the validation of the Mass Casualty Conceptual Model (MCCM). Please refer to the introduction of the model (see the website www.priicon.com/~joule/"Exploration of the MCCM" that provides background information related to the model. I suggest that you print a copy of the model and glossary of terms for reference as you move through the questions. Indicate the best answer for each question. You have one week to complete this online questionnaire. You may leave the survey and then resume it or change answers within the week. If you decide to return it later you MUST use the same computer to resume your answers. At the end of the week, the questionnaire will be closed to further activity.

1. The first series of questions concern your opinion related to the importance of each of the constructs as an appropriate predictor of outcomes of care during mass casualty events.

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<th>Construct</th>
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2. Identify and define any additional construct(s) that in your opinion is needed to adequately predict the outcomes of care during mass casualty events.

3. Recommend any additional changes to the constructs that in your opinion are needed to adequately predict the outcomes of care during mass casualty events.
**Page 2: Construct Relationships**

4. Each of the ten constructs is ordered in a specific hierarchical structure that reflects the influence of the theories/models described in the introduction to the model (see the website introduction). This series of questions concern your opinion related to the importance of the order of these construct relationships among the constructs to provide valid representations of mass casualty triage.

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<tr>
<th>Construct</th>
<th>1 NOT IMPORTANT</th>
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<th>6</th>
<th>CRITICALLY IMPORTANT</th>
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<td>Environmental Context as an influence on the Information Technology environment</td>
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<td>Patients as an influence on the Information Technology environment</td>
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<td>Resources as an influence on the Information Technology environment</td>
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<td>Workforce as an influence on the Information Technology environment</td>
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<td>Information Technology as an influence on the fit to Structure</td>
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<td>Structure as an influence on Triage</td>
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<td>Triage as an influence on Outcomes</td>
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5. Identify and define any additional relationship(s) that in your opinion is needed to adequately assess the continuum of care during mass casualty events.

6. Recommend any additional changes in the relationships that in your opinion are needed to adequately provide valid representation of the continuum of care during mass casualty events.
### Page 3: Indicators (Measures) for Each Construct

It is also important to identify appropriate indicators for each of the constructs, in other words how important are each of the indicators identified as measures for the individual constructs. This series of questions concern your opinion related to the retention, modification or deletion of each of the indicators as appropriate measures for that construct. Please refer to the definition of these terms (see website glossary) that describes each construct and the indicators proposed to measure the construct.

#### 7. Organizational Customs Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
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<tbody>
<tr>
<td>Shared beliefs related to prioritization categories for triage</td>
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<tr>
<td>Life cycle related to growth and stability of the organization</td>
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<tr>
<td>Incentive structure related to punishment/rewards and feedback</td>
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<tr>
<td>Leadership style</td>
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#### 8. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

#### 9. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

#### 10. Triage Unit Organizational Complexity Indicators

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<thead>
<tr>
<th>Indicator</th>
<th>1 Delete</th>
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<th>3 Retain</th>
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<tbody>
<tr>
<td>Number of specialties in workforce</td>
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<tr>
<td>Size of the unit (number of workforce members)</td>
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<tr>
<td>High tech nature of the organization</td>
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<td>Team culture related to self regulation or the ability to delegate tasks, identify communication priorities, and monitor activities; and relationships related to team work</td>
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#### 11. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
12. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

13. Environmental Context Indicators

<table>
<thead>
<tr>
<th>Nature of the disaster (man-made or natural)</th>
<th>1 DELETE</th>
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<tr>
<td>Geographic size of the disaster area</td>
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<td>Warning systems</td>
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<td>Duration of an incident</td>
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<td>Setting (rural or urban)</td>
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14. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

15. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

16. Patient Indicators

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<thead>
<tr>
<th>Injury type and number</th>
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<td>Demographics</td>
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<td>Variability or exceptions to the normal expected cases</td>
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17. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
18. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

19. Resource Indicators

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<thead>
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<th>Categories of resources</th>
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<th>Amount of resources in each category</th>
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<tr>
<th>Location of each resource</th>
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20. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

21. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

22. Workforce Indicators

<table>
<thead>
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<th>Experience</th>
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<th>Skill mix</th>
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</table>
23. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

24. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

25. Information Technology
   Technology Indicators

<table>
<thead>
<tr>
<th>Characteristics related to ergonomics, functionality and amount</th>
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<td>Rate of Flow</td>
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26. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

27. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

28. Information Technology
   Information Indicators
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<td>Security</td>
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<tr>
<td>Characteristics related to: format(s), amount, usability, and completeness</td>
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29. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

30. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

31. Structure Indicators

<table>
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<tr>
<td>Work flow variability or changes in patient triage classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search behaviors or the knowledge, experience and intuition needed by the workforce to make triage decisions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure or the degree of hierarchical to flexible organization needed. This is dependent upon spatial integration or lines of communication and feedback loops.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

32. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

33. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
34. Triage Indicators

<table>
<thead>
<tr>
<th></th>
<th>1 DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to triage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification of patients according to predetermined algorithms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prioritization of patients for treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

35. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.


36. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.


37. Outcome Indicators

<table>
<thead>
<tr>
<th></th>
<th>1 DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overtriage – overestimate of injuries and over treatment resulting in the inappropriate use of limited resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undertriage – underestimate of injuries resulting in potential death or disability</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

38. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.


39. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.


Thank you for taking the time to complete this questionnaire. Please print a copy of your questionnaire so that you may compare your responses to those of the group. Within the next two weeks responses will be summarized and made available in the form of median or the middle response for each question with a depiction of the range of responses for each question as well as any written responses to questions.

Presentation of group responses to each question provides feedback about how panelists answered questions in relation to other panel members. This information is provided to encourage panelists to revise answers during the next round of questions based on the responses of other panel members.

Within the next two weeks you will be notified by email when the feedback from Round 1 is available on the Website (www.u.arizona.edu/~jculey). The email will also notify you that Round 2 questions are available. A hyperlink in the email will take you directly to the Round 2 questionnaire.

Thank you for your valuable time in completing the questionnaire and participating in this study.

Very respectfully,

Joan Culey

Joan M. Culey, PhD-c, RN, CWOCH, MS, MPM
University of Arizona
College of Nursing
Tucson, AZ
Home Phone: 413-355-8766
Email: jculley@nursing.u.arizona.edu
APPENDIX L: SECOND ROUND QUESTIONNAIRE
(As presented on-line through SurveyMonkey)
Page 1: Constructs

Welcome to the second round of questions related to the validation of the Mass Casualty Conceptual Model (MCCM). The model was modified based on a consensus of opinion about any of the constructs, relationships, or indicators from the first round questions. The revised model and responses from the first round questionnaire are available on the website (www.u.arizona.edu/~sculey). Please use the responses and comments from the first round to once again review the model. Comments from the first round should be used to guide your second review of the model. The revised model is the basis for this second round of questions. Constructs, relationships and indicators that met the criteria for consensus from the first round of questions have been removed from the second round questionnaire. Indicate the best answer for each question.

The last two pages of the questionnaire ask for your input and comments on the usefulness of the model and the usefulness of the online process.

You have one week to complete this online questionnaire. You may leave the survey and then resume it or change answers within the week. If you decide to resume it later you MUST use the same computer to resume your answers. At the end of the week, the questionnaire will be closed to further activity.

1. The first series of questions concern your opinion related to the importance of each of the constructs as an appropriate predictor of outcomes of care during mass casualty events.

<table>
<thead>
<tr>
<th>Construct</th>
<th>1 NOT IMPORTANT</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7 CRITICALLY IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workforce</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Identify and define any additional construct(s) that in your opinion is needed to adequately predict the outcomes of care during mass casualty events.

3. Recommend any additional changes to the constructs that in your opinion are needed to adequately predict the outcomes of care during mass casualty events.
4. Each of the ten constructs is ordered in a specific hierarchical structure that reflects the influence of the theories/models described in the introduction to the model (see the website introduction). This series of questions concern your opinion related to the importance of the order of these construct relationships among the constructs to provide valid representations of mass casualty triage.

<table>
<thead>
<tr>
<th>Construct</th>
<th>1 NOT IMPORTANT</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7 CRITICALLY IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs as an influence on the Information Technology environment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity as an influence on the Information Technology environment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Environmental Context as an influence on the Information Technology environment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Patients as an influence on the Information Technology environment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Resources as an influence on the Information Technology environment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Workforce as an influence on the Information Technology environment</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Information Technology as an influence on the fit to Structure</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Structure as an influence on Triage</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Triage as an influence on Outcomes</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

5. Identify and define any additional construct(s) that in your opinion is needed to adequately predict the outcomes of care during mass casualty events.

6. Recommend any additional changes in the relationships that in your opinion are needed to adequately provide valid representation of mass casualty triage.
Page 3: Indicators (Measures) for Each Construct

It is also important to identify appropriate indicators for each of the constructs, in other words how important are each of the indicators identified as measures for the individual constructs. This series of questions concern your opinion related to the retention, modification or deletion of each of the indicators as appropriate measures for that construct. Please refer to the definition of these terms (see website glossary) that describes each construct and the indicators proposed to measure the construct.

7. Organizational Customs Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared beliefs related to prioritization categories for triage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life cycle related to growth and stability of the organization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incentive structure related to punishment/rewards and feedback</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

9. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

10. Triage Unit Organizational Complexity Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of specialties in workforce</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High tech nature of the organization</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

12. Recommend any additional changes to the indicators that in your opinion are
13. Environmental Context Indicators

<table>
<thead>
<tr>
<th>Setting (rural or urban)</th>
<th>1. DELETE</th>
<th>2. MODIFY</th>
<th>3. RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

15. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

16. Patient Indicators

<table>
<thead>
<tr>
<th>Demographics</th>
<th>1. DELETE</th>
<th>2. MODIFY</th>
<th>3. RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

17. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

18. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
19. Resource Indicators

<table>
<thead>
<tr>
<th>Availability of resources in each category</th>
<th>1 DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
</table>

20. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

21. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

22. Workforce Indicators

<table>
<thead>
<tr>
<th>Credentials/Licenses</th>
<th>1 DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience with technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill mix</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needs related to safety and health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

24. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
25. Information Technology
Technology Indicators

<table>
<thead>
<tr>
<th>Characteristics related to ergonomics, functionality and amount</th>
<th>1 DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Flow</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

26. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

27. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

28. Information Technology
Information Indicators

<table>
<thead>
<tr>
<th>Termination</th>
<th>1 DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristics related to: currency, access, format(s), amount, usability, and completeness</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

29. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

30. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
31. Structure Indicators

<table>
<thead>
<tr>
<th>Structure or the degree of hierarchical to flexible organization needed. This is dependent upon spatial integration or lines of communication and feedback loops.</th>
</tr>
</thead>
<tbody>
<tr>
<td>L DELETE</td>
</tr>
</tbody>
</table>

32. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

33. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

34. Outcomes Patient Indicators

<table>
<thead>
<tr>
<th>Survival</th>
<th>L DELETE</th>
<th>2 MODIFY</th>
<th>3 RETAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

35. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

36. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
37. Outcomes
Resource indicators

Overtriage – overestimate of injuries and over treatment resulting in the inappropriate use of limited resources


38. Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

39. Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

USEFULNESS OF THE MODEL

40. In your opinion how useful is this model to the further study of information and technology requirements during mass casualty events?

Rate the usefulness of the model

1. Not Useful  2  3  4  5  6  7 Very Useful

41. Please include any addition comments regarding the usefulness of the model.
### PAGE 4: USEFULLNESS OF THE ONLINE PROCESS FOR THIS RESEARCH

The next eight questions are designed to evaluate the usefulness of the online process for this research.

**42. Please rate the usefulness of the following for this Delphi Process:**

<table>
<thead>
<tr>
<th></th>
<th>1 NOT USEFUL</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7 VERY USEFUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webpage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrated Instructions about the Delphi Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrated Explanation of the MCCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online Glossary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online Questionnaires</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**43. Approximately how many minutes did it take you to complete the first round questionnaire?**


**44. Approximately how many minutes did it take you to complete the second round questionnaire?**


**45. Please include any additional comments regarding the use of an online process for this study.**


Thank you for taking the time to participate in this study. Once the final results of the study are completed I will make the results available on the website. You will be notified by email once the study results are available.
APPENDIX M: SURVEYMONKEY DATA SECURITY INFORMATION
SURVEYMONKEY DATA SECURITY INFORMATION

Our privacy policy states that we (SurveyMonkey) will not use your data for our own purposes. The data you collect is kept private and confidential.

In regards to the security of our infrastructure, here is an overview of our setup.

The servers are kept at SunGard.
http://www.sungard.com

Physical

- Servers kept in locked cage
- Entry requires a passcard and biometric recognition
- Digital surveillance equipment
- Controls for temperature, humidity and smoke/fire detection
- Staffed 24/7

Network

- Multiple independent connections to Tier 1 Internet access providers
- Fully redundant OC-48 SONET Rings
- Uptime monitored every 5 minutes, with escalation to SurveyMonkey staff
- Firewall restricts access to all ports except 80 (http) and 443 (https)
- QualysGuard network security audits performed quarterly

Hardware

- Servers have redundant internal power supplies
- Data is on RAID 10, operating system on RAID 1

Software

- Code in ASP, running on SQL Server 2000 and Windows 2000 Server
- Latest patches applied to all operating system and application files
- SSL encryption of all billing data
- Data backed up every hour internally
- Data backed up every night to centralized backup system, with offsite backups in event of catastrophe

Expert Panel:
All of the data from the Round 1 questionnaire of the validation of the Mass Casualty Model has been analyzed and is available for your review on the study website (www.u.arizona.edu/~jculley) under the ROUND 1 FEEDBACK link.

Minor modifications were made in the model based on a consensus of opinion about any of the constructs, relationships, or indicators from the first round questions. The revised model and responses from the first round questionnaire are available on the website (www.u.arizona.edu/~jculley) under the ROUND 1 FEEDBACK link. Please use the responses and comments from the first round to once again review the model. Comments from the first round should be used to guide your second review of the model and provide the basis for your responses to Round 2 of the Delphi process.

Round 2 of the Delphi process is now available. You will receive a notice and a link to the Round 2 questionnaire.

Constructs, relationships and indicators that met the criteria for consensus from the first round of questions have been removed from the second round questionnaire.

The last two pages of the questionnaire ask for your input on the usefulness of the model and the usefulness of the online process.

You have seven days to complete this online questionnaire. You may leave the survey and then resume it or change answers within the week. If you decided to resume it later you MUST use the same computer to resume your answers. On August 31st the questionnaire will be closed to further activity. This allows everyone to enjoy the Labor Day holiday weekend!

Once the data from Round 2 of the validation process is completed you will be notified if a third round is necessary. Consensus on all constructs, relationships and indicators signify the end of the Delphi process.

Thank you for your valuable time in helping with this research. You opinions and comments are greatly appreciated.

Very Respectfully,
Joan Culley
(H) 413-256-8786
APPENDIX O: FEEDBACK FROM ROUND ONE
SUMMARY OF RESPONSES TO ROUND 1 OF THE VALIDATION OF THE MASS CASUALTY CONCEPTUAL MODEL (MCCM)

The following summarizes your responses to the first series of questions concerning your opinions related to the importance of each construct, relationship and indicator as an appropriate predictor of outcomes of care during mass casualty events. The response rate was 88%; 16 out of 18 expert panel members responded to Round 1. Summary information includes:

- Histograms that summarize the number of respondents that rated each construct and relationship as:
  - 1 Not Important to 7 Critically Important
- Tables that include median responses for each construct and relationship as well as the status of consensus. Less than one scale point is required to reach consensus on the first round.
- Histograms that summarize the percent agreement among respondents that rated each indicator or measure for each construct as:
  - 1 = Delete  2 = Modify  3 = Retain
- Tables that include the percent agreement rates for each construct indicator. Percent agreement of 70% or greater is required to reach consensus on the first round.
- Any comments included by respondents related to constructs, relationships or indicators are included.
- Once consensus is reached the construct, relationship or indicator is removed from the next round of questions.
Example: Construct Related to Organizational Customs Indicates:

- 1 respondent rated Organizational Customs a 1 or not important
- 0 respondents rated Organizational Customs as 2
- 4 respondents rated Organizational Customs as 3
- 1 respondent rated Organizational Customs as 4
- 2 respondents rated Organizational Customs as 5
- 4 respondents rated Organizational Customs as 6
- 4 respondents rated Organizational Customs as 7 or critically important
CONSTRUCTS

Table 1: Median Responses from 1 = Not Important to 7 = Critically Important and Status of Consensus related to the Ten Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Median Response</th>
<th>Spread of Scale Points</th>
<th>Status of Consensus (≤ 1 Scale Point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs</td>
<td>5.5</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Triage Unit</td>
<td>6.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Organizational Complexity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Context</td>
<td>6.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Patients</td>
<td>6.0</td>
<td>1.3</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>Resources</td>
<td>6.0</td>
<td>0.5</td>
<td>Consensus Reached to Retain</td>
</tr>
<tr>
<td>Workforce</td>
<td>6.0</td>
<td>1.3</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>Information Technology</td>
<td>5.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td>5.0</td>
<td>1.3</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>Triage</td>
<td>6.0</td>
<td>1.3</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>Outcomes</td>
<td>6.0</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:
Identify and define any additional construct(s) that in your opinion is needed to adequately predict the outcomes of care during mass casualty events.

- Better pre-hospital triage of the patient so the ER has a "heads up" on what to expect in terms of the disaster scene, patient's injuries, and status of patient. This can be accomplished with video/photos being transmitted to ER while ambulance is en route, any by better ETA predication with GPS in ambulance and real time tracking on map in the ER.
- Care should not stop with only outcomes related to triage. Perhaps immediate outcomes, followed by care regimen quantified in days, then mid-term to long-term outcomes
- The level of preparedness planning initiated prior to the event including the number of drills and exercises (needed to identify the extent of material resources and staff needed to respond to either real or imagined events).
- Severity of injury; access to patients
- Cultural norms on the ground need to be clear.
- Political environment: From a US national sense this would include factors such as current support, or lack there of in governmental leaders; how politically charged is the event (i.e. 9/11 or Pearl Harbor vs. the poor, black citizens of New Orleans); perhaps there is also an element of the level of corruption in the response agencies (i.e. leaders who are political appointees rather than experienced professionals. From an international sense how safe/secure is any given area from civil unrest, what is the infrastructure of the area and again political corruption. (i.e. relief funds never making it to intended destinations).
• Communication capability
• Under "Resources", in addition to Categories, Amount, & Location, should there be reference to the "Where" or source, or the Resources?
• Community Disaster Plans that identify the resources, workforce, mutual aid and establish agreements with providers.
• Physical structure to provide care: I don't see this included in either 'environmental context' or 'structure'. Safety: Outcomes will be influenced if there are not adequate safety measures in place to protect providers and patients. This might not need to be a separate construct but could be integrated into one on your list.
• Exercising - Every component of a mass casualty response needs be exercised. Strengths, weaknesses and gaps need to be identified. Corrective action plans established and plan modification to follow. If a workforce has not been educated and proficient in triage related to an anthrax event,
• Financial - In some cases monies must be made available at the time of the incident. Some of the resources will need to be paid, or shall authorize payment before a resource is made available. This is why someone from administration / finance is part of the Incident Command Staff. Public Relations - Also is key, but it is not addressed in the resource or organization constructs identified above. Getting the information out in the appropriate manner is key to making sure the incident goes and smoothly as possible. Again, this is the reason why Public Affairs/Public Relations is identified in the Command Staff.

**Recommend any additional changes to the constructs that in your opinion are needed to adequately predict the outcomes of care during mass casualty events.**

• The ability of personnel to effectively utilize existing technology, experience with equipment, knowledge of key forms, and known rate of work.
• Answering items above is difficult if I believe that IT should be part of the contextual environment rather than its own stage; mid-range and long-term outcomes should be added as mentioned in earlier item
• Community Disaster Plans as discussed in the preceding section
• Pre-planning and Training should be an actual construct(s). They are strategically much more important to the outcome of any MCI than Information Technology, Triage and Resources and probably should be more highly placed than it is in the Workplace Construct.
• The quality, methodology and frequency of exercises can provide strong data point to help predict the outcome of care during a mass casualty event.
Example: Constructual Relationship Related to Organizational Customs as an Influence on the Information Technology Environment Indicates:

- 0 respondents rated Organizational Customs as 1
- 4 respondents rated Organizational Customs as 2
- 2 respondents rated Organizational Customs as 3
- 0 respondents rated Organizational Customs as 4
- 5 respondents rated Organizational Customs as 5
- 3 respondents rated Organizational Customs as 6
- 2 respondents rated Organizational Customs as 7 or critically important
Table 2: Median Response from 1 = Not Important to 7 = Critically Important and Status of Consensus Related to Relationships

<table>
<thead>
<tr>
<th>Construct</th>
<th>Median Response</th>
<th>Spread of Scale Points</th>
<th>Status of Consensus (≤ 1 Scale Point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs as an influence on the Information Technology environment</td>
<td>5.0</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity as an influence on the Information Technology environment</td>
<td>4.5</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Environmental Context as an influence on the Information Technology environment</td>
<td>5.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Patients as an influence on the Information Technology environment</td>
<td>5.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Resources as an influence on the Information Technology environment</td>
<td>5.5</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Workforce as an influence on the Information Technology environment</td>
<td>6.0</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Information Technology as an influence on the fit to Structure</td>
<td>5.0</td>
<td>2.0</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>Structure as an influence on Triage</td>
<td>5.5</td>
<td>1.3</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>Triage as an influence on Outcomes</td>
<td>6.0</td>
<td>1.3</td>
<td>Very Close to Consensus</td>
</tr>
</tbody>
</table>

COMMENTS:
Identify and define any additional relationship(s) that in your opinion is needed to adequately assess the continuum of care during mass casualty events.

- The ability of personnel to effectively utilize existing technology, experience with equipment, knowledge of key forms, and known rate of work.
- Answering items above is difficult if I believe that IT should be part of the contextual environment rather than its own stage; mid-range and long-term outcomes should be added as mentioned in earlier item
- Community Disaster Plans as discussed in the preceding section
I would have given some of the constructs above a higher mark, except that they were listed with either order of importance mixed up (my opinion), or that they identified issues that were so far down on the importance list at an MCI that it further reduced the priority level.

Recommend any additional changes in the relationships that in your opinion are needed to adequately provide valid representation of the continuum of care during mass casualty events.

- Triage can be collapsed into structural environment because how it is organized definitely reflects on later outcomes
- Some of the items addressed in the individual constructs are very low on the importance scale, and some issues need to be made more significant. When you're talking about an MCI where you are dependent on mutual aid agreements (personnel turnover) and size of operations you won't be concerned with punishment and reward, technology (which may not arrive) skill mix, licenses and credentials etc.
Example: Organizational Custom Indictors show:

- 38% of respondents indicated to DELETE the number of specialties in the workforce
- 6% of respondents indicated to MODIFY the number of specialties in the workforce
- 56% of respondents indicated to RETAIN the number of specialties in the workforce
INDICATORS FOR EACH CONSTRUCT

Table 3: Percent Agreement Related to Indicators for Organizational Customs Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Shared beliefs related to prioritization categories for triage</td>
<td>38%</td>
<td>6%</td>
<td>56%</td>
<td></td>
</tr>
<tr>
<td>b. Life cycle related to growth and stability of the organization</td>
<td>19%</td>
<td>31%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>c. Incentive structure related to punishment/rewards and feedback</td>
<td>31%</td>
<td>6%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>d. Leadership style</td>
<td>7%</td>
<td>14%</td>
<td>79%</td>
<td>Consensus Met to Retain</td>
</tr>
</tbody>
</table>

COMMENTS:

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- Prior organization experience in dealing with mass casualty events
- The Incident Command System (ICS) is required to be integrated into all hazard planning. ICS is management system that clearly defines roles, responsibilities and systems for a unified and streamlined response. I feel an organizations’ structure should be included as an indicator.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- Feedback is important; punishment/reward leads to potential for power-grab, or favoritism  
  Shared beliefs is potentially problematic; too many gray areas may delay action which may require black/white decisions.
- Patient priorities should already have been addressed before an MCI actually happens. Patients are triaged (primary, secondary, treatment areas and loading areas), which has or is done during MCI training long before the MCI incident happens.
### Triage Unit Organizational Complexity Indicators Percent Agreement

<table>
<thead>
<tr>
<th>Indicator</th>
<th>RESPONSES</th>
<th>PERCENT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of specialties in workforce</td>
<td>1 = DELETE</td>
<td>13.3</td>
</tr>
<tr>
<td>Size of the unit (number of workforce members)</td>
<td>2 = MODIFY</td>
<td>66.7</td>
</tr>
<tr>
<td>High tech nature of the organization</td>
<td>3 = RETAIN</td>
<td>21.4</td>
</tr>
<tr>
<td>Team culture related to self regulation, ability to delegate tasks, identify communication priorities, and monitor activities; and relationships related to team work</td>
<td>1 = DELETE</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>2 = MODIFY</td>
<td>85.7</td>
</tr>
</tbody>
</table>
Table 4: Percent Agreement Related to Indicators for Triage Unit Organizational Complexity Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triage Unit Organizational Complexity Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Number of specialties in workforce</td>
<td>13%</td>
<td>20%</td>
<td>67%</td>
<td>Close to Consensus</td>
</tr>
<tr>
<td>b. Size of the unit (number of workforce members)</td>
<td>14%</td>
<td>14%</td>
<td>72%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>c. High tech nature of the organization</td>
<td>21%</td>
<td>36%</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>d. Team culture related to self regulation or the ability to delegate tasks, identify communication priorities, and monitor activities; and relationships related to team work</td>
<td>0%</td>
<td>14%</td>
<td>86%</td>
<td>Consensus Met to Retain</td>
</tr>
</tbody>
</table>

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- More emphasis needed on skill mix vs. "specialties in workforce"; for example, a cadre of general volunteers might prove more valuable than specialists in many situations.
- Did you combine tech readiness with high tech? According to page 3 of your powerpoint they were two separate indicators but weren't listed so above. Confusing. I think they should be combined into technology abilities as the indicator

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- Recommend editing 'high tech nature of organization' to 'technological sophistication of organization'.
- I think "high tech nature of the organization" needs to be clarified.
- Cross-train certain specialties and support staff so that number individuals with certain specialties can be reduced thereby possibly reducing then number workforce members.
- Every incident is going to call upon different people to work together, through mutual aid agreements and tours/shifts. Any team has to be able to adapt, and it will always be different personnel especially when you are talking about Volunteer and Call fire departments. Technology, specialties etc. are fine for bigger departments that have specialized
people, but the greatest number of responding agencies are small, and this is too complex for the majority. We need to train the greatest number of people in a way that they will easily understand.

- High Tech- triage algorithms exist that define treatment procedures. Team members should be "proficient" in the triage/treatment modalities. There should be no un-familiar procedures. In relation to new threats (i.e. anthrax)...the proficiency of the team in these new threat responses can have an affect on patient outcome. Team Culture- I don't think the term is used appropriately. Consistent and standardized training can develop a team synergy that produces positive patient outcomes. Exercising....I feel strongly that exercising needs to be incorporated in the model....possible within this section.
Table 5: Percent Agreement Related to Indicators for Environmental Context Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Environmental Context Indicators</th>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Nature of the disaster (man-made or natural)</td>
<td></td>
<td>6%</td>
<td>19%</td>
<td>75%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>b. Geographic size of the disaster area</td>
<td></td>
<td>0%</td>
<td>13%</td>
<td>87%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>c. Warning systems</td>
<td></td>
<td>13%</td>
<td>13%</td>
<td>74%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>d. Duration of an incident</td>
<td></td>
<td>0%</td>
<td>13%</td>
<td>87%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>e. Setting (rural or urban)</td>
<td></td>
<td>19%</td>
<td>25%</td>
<td>56%</td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

- Direct impact of response agencies (emergency responders, government services, etc.).
- As noted, discuss inclusion of suburban
- Level of disaster (i.e. state, regional, national, international)
- As an example, begin with the type of Natural or Man-made disasters and work in the other direction. Urban and rural are too gray. Training as to be an integral part of all theses constructs.
- Weather In an intentional anthrax release, wind patterns can affect how a response is initiated. Snowy conditions can affect the patient outcomes during a mass casualty event.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

- I prefer to categorize disasters as natural, unintentional or deliberate (Reference: C. Perrow 'Disasters Ever more? Reducing U.S. vulnerabilities' in Handbook of Disaster Research by Rodriguez, Quarantelli and Dynes (2006). These labels include all disasters, industrial accidents, geographic and weather events, and acts of terror. 'Manmade' is not gender neutral and although many people continue to use it, I don't. I also don't think it covers industrial/transportation accidents. 2. I have concern about the 'nature of disaster' indicator. This is a complex area I've had to work on also. I believe, and most disaster experts assert, that a disaster is the effect of an agent or event on a vulnerable human society. Therefore the disaster is not the tornado or flood - but the disrupted human social system. 3. In your glossary, you identify types of disaster - you may wish to broaden these and reconsider you conceptualization. If you conceptualize disaster as a social disruption, power loss is one indicator of a disaster but hurricane (only one type of windstorm) and...
flood are the CAUSE of the disaster. Your list of disasters is missing volcano, extreme temperature events, slides (mud earth, etc.), wildfire, and earthquake. You may want to look at how CRED categorizes disasters at http://www.cred.be/

- Why are rural or urban important...they are not universally defined the same way. Rural in New England is quite different than Arizona...I think.
- Competing disasters should be an indicator, in other words if there are floods in North Carolina at the same time there is a hurricane in New Orleans it becomes a resource issue. Don't understand how the warning systems impacts the context - even with warnings damage can still occur
PATIENT INDICATORS PERCENT AGREEMENT

Injury type and number
Demographics
Variability or exceptions to the normal expected cases

1 = DELETE
2 = MODIFY
3 = RETAIN

PERCENT (%)

RESPONSES
Table 6: Percent Agreement Related to Indicators for Patient Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Injury type and number</td>
<td>6%</td>
<td>13%</td>
<td>81%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>b. Demographics</td>
<td>19%</td>
<td>25%</td>
<td>56%</td>
<td></td>
</tr>
<tr>
<td>c. Variability or exceptions to the normal expected cases</td>
<td>0%</td>
<td>19%</td>
<td>81%</td>
<td>Consensus Met to Retain</td>
</tr>
</tbody>
</table>

COMMENTS:

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

- What about care for those who had existing disabilities and chronic disease? Superimposed with a disaster they will no longer be coping effectively and need help. Same with needs for pregnant and nursing women and children.
- First two are not necessary factors. You deal with what you have, and it will be different every time. Injury types and demographics are not important factors when we respond to an incident. Age and gender are not something we should take into consideration, unless you are specifically talking about an MCI at a Nursing Home.
- I would recommend you make one category "Patient Variability" that would include injury type, number, demographics etc.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

- Strongly recommend changing the use of 'medical' conditions' to 'health' conditions (and any other use of medical). In my opinion, medical refers to the practice of medicine by physicians. I do not consider it an umbrella term and prefer the use of 'health' and 'health care' to describe all activities carried out to maintain and improve health.
- I think you need to move to the demographic sub categories....Demographics, as a term, is too vague.
<table>
<thead>
<tr>
<th>RESPONSES</th>
<th>PERCENT (%)</th>
<th>RESOURCE INDICATORS PERCENT AGREEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categories of resources</td>
<td>73.3%</td>
<td>1 = DELETE</td>
</tr>
<tr>
<td>Amount of resources in each category</td>
<td>33.3%</td>
<td>2 = MODIFY</td>
</tr>
<tr>
<td>Location of each resource</td>
<td>20.0%</td>
<td>3 = RETAIN</td>
</tr>
</tbody>
</table>

### Graph Details

- **Y-axis**: Percent (%)
- **X-axis**: Resources (Categories, Amounts, Locations)
- **Legend**:
  - 1 = DELETE
  - 2 = MODIFY
  - 3 = RETAIN
Table 7: Percent Agreement Related to Indicators for Resource Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Categories of resources</td>
<td>0%</td>
<td>27%</td>
<td>73%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>b. Amount of resources in each category</td>
<td>0%</td>
<td>33%</td>
<td>67%</td>
<td>Close to Consensus</td>
</tr>
<tr>
<td>c. Location of each resource</td>
<td>7%</td>
<td>20%</td>
<td>73%</td>
<td>Consensus Met to Retain</td>
</tr>
</tbody>
</table>

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- Actual funding / expendables/ sources.
- Transport needs for resources not currently on site.
- Availability of resources 24/7 and 365 days a year.
- Change Amount of resources to "availability". It can encompass not only the amount available, but the re-supply.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- You may wish to add 'logistics' to the indicators as moving resources to the location where they are needed in disaster can be complex.
- Identify key resources needs for each anticipated type of natural/man-caused disaster. Identify commonly listed resources and insure that at a minimum those resources are maintained in adequate supply and are strategically located.
Table 8  Percent Agreement Related to Indicators for Workforce Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workforce Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Credentials/Licenses</td>
<td>12%</td>
<td>25%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>b. Experience</td>
<td>6%</td>
<td>6%</td>
<td>88%</td>
<td><strong>Consensus Met to Retain</strong></td>
</tr>
<tr>
<td>c. Experience with technology</td>
<td>13%</td>
<td>31%</td>
<td>56%</td>
<td></td>
</tr>
<tr>
<td>d. Training</td>
<td>0%</td>
<td>12%</td>
<td>88%</td>
<td><strong>Consensus Met to Retain</strong></td>
</tr>
<tr>
<td>e. Skill mix</td>
<td>19%</td>
<td>25%</td>
<td>56%</td>
<td></td>
</tr>
<tr>
<td>f. Education</td>
<td>12%</td>
<td>25%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>g. Needs related to safety and health</td>
<td>0%</td>
<td>31%</td>
<td>69%</td>
<td><strong>Very close to Consensus</strong></td>
</tr>
<tr>
<td>h. Age</td>
<td>47%</td>
<td>47%</td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS:**

**Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.**
- Strongly encourage revising 'needs related to safety and health' to 'willingness to work'. A body of science is emerging that indicates health care personnel may not be willing to work in all disaster situations. Concerns about health and personal safety are only two of the reasons - others include concern for pets and family members, fear, etc.
- Perhaps physical health, disability and handicap should be considered somewhere in the mix.
- Estimated service time - ie how long workforce is expected to serve and in what shifts

**Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.**
- Age: I'm not sure there is evidence to support the statement that maturity may influence the ability to 'handle (???)' events.
- For the above indicators that I marked as "," I think there needs to be further clarification. "Experience with technology" - what kind of technology are you referencing? Skill mix - what do you mean by this? "Needs related to safety and health" - their personal needs (in terms of feeling that these items have been met), personal protective equipment? Age - responders younger than a certain age? Older than a certain age?
- Age is not critical...the ability to meet demanding (tiring, strength) operations, on the other hand, is.
- Is there overlap in education/credentials/licensure as separate indicators? I am questioning whether age is a meaningful indicator of maturity in mass casualty event, I prefer experience.
• Age can be problematic; depending on needs, workforce may require physical fitness as a sub category versus age.
• Don't see how one can adequately measure age via maturity
• Credentialing should be addressed within "Triage Level Organizations Complexity Indicators" ....."number of specialties".
INFORMATION TECHNOLOGY: TECHNOLOGY INDICATORS PERCENT AGREEMENT

1 = DELETE  2 = MODIFY  3 = RETAIN

Characteristics related to ergonomics, functionality and amount

Work Flow Rate of Flow

Responses

Percent (%)
Table 9: Percent Agreement Related to Indicators for Information Technology (Technology) Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology (Technology Indicators)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Characteristics related to ergonomics, functionality and amount</td>
<td>20%</td>
<td>33%</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>b. Work Flow</td>
<td>13%</td>
<td>20%</td>
<td>67%</td>
<td>Close to Consensus</td>
</tr>
<tr>
<td>c. Rate of Flow</td>
<td>13%</td>
<td>20%</td>
<td>67%</td>
<td>Close to Consensus</td>
</tr>
</tbody>
</table>

COMMENTS:

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- Ergonomics, I think, is important over the long haul but not at the time of an incident.
- What about power needs? What about Internet availability? What about connections to other servers etc.
- Multiple ways to access and process, and share data even when power and towers are down.
- Determining the type of data that will need to be collected will be event driven. There are basic demographic points, but during a BT event minimal demographic points might be the only data that can be collected due to the nature of the disease/event.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- This entire category seems unclear to me. Is there some way to better explain the types of technology and/or what types of information you believe would have an impact on triage?
- Workforce needs to be familiar with their current organizational data collection systems. As well as the redundant system (plain ole paper and pencil)
INFORMATION TECHNOLOGY: INFORMATION INDICATORS PERCENT AGREEMENT

Terminology

Flow

Security

Characteristics related to: format(s), amount, usability, and completeness

RESPONSES

PERCENT (%)

1 = DELETE
2 = MODIFY
3 = RETAIN
**Table 10: Percent Agreement Related to Indicators for Information Technology (Information Indicators) Construct and Status of Consensus**

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology (Information Indicators)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Terminology</td>
<td>0%</td>
<td>31%</td>
<td>69%</td>
<td>Very Close to Consensus</td>
</tr>
<tr>
<td>b. Flow</td>
<td>0%</td>
<td>13%</td>
<td>87%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>c. Security</td>
<td>12%</td>
<td>25%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>d. Characteristics related to:</td>
<td>14%</td>
<td>21%</td>
<td>65%</td>
<td></td>
</tr>
<tr>
<td>format(s), amount, usability, and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>completeness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS:**

**Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.**

- What about access to information? What about communication to end users regarding any updates/changes to the system?
- Redundancy of data storage
- Determining the type of data that will need to be collected will be event driven. There are basic demographic points, but during a BT event minimal demographic points might be the only data that can be collected due to the nature of the disease/event.

**Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.**

- Security: Suggest deleting 'possible terrorists'; change to inappropriate uses or use by unauthorized users.  HIPAA is correct acronym (not HIPPAA).
- Same comment as #27.
- On characteristics: This sounds too bureaucratic.
- Add "Availability" to Information
- Under characteristics related to: add, accuracy (it is in your glossary but not here) and a process to maintain currency
- Under security add security of servers and security of information (password protected sensitive data, limited screen time when not in use)
• Workforce needs to be familiar with their current organizational data collection systems. As well as the redundant system (plain ole paper and pencil)
• Standard nomenclature is vital. ICS uses standard language across response organizations. Each discipline will need to adopt response terminology (industry standards) to ensure proper communications with EOC, medical community partners and patients...etc.
Work flow variability or changes in patient triage classification

Search behaviors or the knowledge, experience and intuition needed by the workforce to make triage decisions

Structure or the degree of hierarchical to flexible organization needed. This is dependent upon spatial integration or lines of communication and feedback loops.
Table 11: Percent Agreement Related to Indicators for Structure Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Work flow variability or changes in patient triage classification</td>
<td>0%</td>
<td>19%</td>
<td>81%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>b. Search behaviors or the knowledge, experience and intuition needed by the workforce to make triage decisions</td>
<td>0%</td>
<td>25%</td>
<td>75%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>c. Structure or the degree of mechanistic (bureaucratic) to organic organization needed. This is dependent upon spatial integration or lines of communication and feedback loops.</td>
<td>7%</td>
<td>33%</td>
<td>60%</td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
None

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- The last point is not clear in terms of what it means. Is there some way of explaining this in more simple terms?
- Degree of hierarchical needs to be further developed- more concrete.
- Don't know how you will measure search behaviors.
- Wording is too generic and needs to be easier for the first responder to adapt to.
- See above-most of my comments are relatable to these indicators
TRIAGE INDICATOR PERCENT AGREEMENT

1 = DELETE  2 = MODIFY  3 = RETAIN

Time to triage
Classification of patients according to predetermined algorithms
Prioritization of patients for treatment

PERCENT (%)
Table 12: Percent Agreement Related to Indicators for Triage Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triage Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Time to triage</td>
<td>0%</td>
<td>19%</td>
<td>81%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>b. Classification of patients according to predetermined algorithms</td>
<td>0%</td>
<td>19%</td>
<td>81%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>c. Prioritization of patients for treatment</td>
<td>0%</td>
<td>12%</td>
<td>88%</td>
<td>Consensus Met to Retain</td>
</tr>
</tbody>
</table>

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- Feedback regarding resources
- If their triage indicated a need for referrals to meet the victim's need (eyeglass provider) was the referral successful for recovery stage (did they get their eyeglasses in a reasonable time frame?)

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- Again your definitions under triage indicate the emergent phase and not the recovery phase which should say something about ongoing assessment to ensure that the victim's needs are met. Were the referrals successful?
Table 13: Percent Agreement Related to Indicators for Outcome Construct and Status of Consensus

<table>
<thead>
<tr>
<th>Construct Indicators (Patient Outcomes)</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Status of Consensus (≥ 70% Agreement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overtriage</td>
<td>13%</td>
<td>20%</td>
<td>67%</td>
<td>Close to Consensus</td>
</tr>
<tr>
<td>Undertraige</td>
<td>7%</td>
<td>20%</td>
<td>73%</td>
<td>Consensus Met to Retain</td>
</tr>
</tbody>
</table>

COMMENTS:

**Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.**

- I don't think 'outcome indicators' can be predictors of outcomes. Perhaps this just needs to be retiled something like 'estimation of injuries'.
- Were the victims' needs met (did they get their medications in a reasonable time frame, was the dialysis unit able to treat them in a reasonable time frame)

**Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.**

- Great job Joan!
- Still say this model should not stop with immediate outcomes from triage, but go further in the process. Note: if you want us to print this questionnaire then you should provide a print button, printing only gives us this page without any checkmarks. Thought you should know and provide a place for other comments
- Not necessary. Should have been addressed in MCI training. In an MCI incident Overtriaging should always be the norm. Please take into consideration that the greatest number of responders are Call and Volunteer. Instructional diagrams, matrixes and training presentations have to be easy to understand, clear and only provide only the absolute information necessary. It needs to be much more user friendly.
MASS CASUALTY CONCEPTUAL MODEL (MCCM) ©

STAGE I: CONTEXTUAL ENVIRONMENT

EMERGENCY OPERATION CENTER LEVEL

ORGANIZATIONAL CUSTOMS

TRIAGE LEVEL

TRIAGE UNIT ORGANIZATIONAL COMPLEXITY

ENVIRONMENTAL CONTEXT

PATIENTS

RESOURCES

WORKFORCE

INFORMATION TECHNOLOGY

STRUCTURE

TRIAGE

OUTCOMES

Grey indicates that consensus is reached to retain
Mass Casualty Conceptual Model Stage I: Contextual Environment

**EMERGENCY OPERATION CENTER LEVEL**

- Growth
- Stability
- Punishment/Rewards
- Feedback

**Shared Beliefs (Prioritization)**

**Life Cycle (Longevity)**

**Incentive Structure**

**Leadership Style**

**TRIAGE LEVEL**

- Delegate Tasks
- Identify Communication Priorities
- Monitor Activities
- Team work

- Self Regulation
- Relationships

- Number of Specialties
- Size
- Technology Readiness
- High Tech
- Team Culture

**ORGANIZATIONAL COMPLEXITY**

Grey indicates that consensus is reached to retain
Mass Casualty Conceptual Model Stage I: Contextual Environment (Continued)

TRIAGE LEVEL

Nature of Disaster
Geographical Size
Duration
Warning Systems
Setting
Rural
Urban

Grey indicates that consensus is reached to retain
Terms modified/added to be more inclusive
Mass Casualty Conceptual Model Stage I: Contextual Environment (Continued)

**TRIAGE LEVEL**

- Injury (#, Type)
- Demographics
- Variability (Exceptional Cases)

**PATIENTS**

- Credentials/Licenses
- Experience
- Experience with Technology
- Training
- Skill Mix
- Education
- Safety and Health Needs
- Age

**WORKFORCE**

- Categories
- Availability
- Location

**RESOURCES**

Grey indicates that consensus is reached to retain

**Term modified to be more inclusive**
Mass Casualty Triage Conceptual Model Stage II: Information Environment

**TRIAGE LEVEL**

- Ergonomics
- Functionality
- Amount

- Characteristics
  - Work Flow
  - Rate of Flow

- Technology
  - Hard/Soft

- Information
  - Terminology
  - Flow
  - Security
  - Characteristics

**INFORMATION/TECHNOLOGY**

Grey indicates that consensus is reached to retain

**Term added to be more inclusive**
Mass Casualty Triage Conceptual Model Stage III: Structural Environment

**TRIAGE LEVEL**

Changes in Patient Triage Classification

Knowledge, Experience Intuition

Hierarchical to Flexible

Work Flow Variability

Search Behaviors

Structure

Grey indicates that consensus is reached to retain
Mass Casualty Conceptual Model Stage IV: Triage

TRIAGE LEVEL

Grey indicates that consensus is reached to retain
Mass Casualty Triage Conceptual Model Stage V: Goals

**TRIAGE LEVEL**

- Survival
- Disabled
- Overtriage
- Undertriage

**OUTCOMES**

- Patient Outcomes
- Resource Outcomes

Grey indicates that consensus is reached to retain
THANK YOU, THANK YOU, THANK YOU!

HOORAH IT IS OVER!!! YOU ARE OFF THE HOOK!

I am pleased to announce that all of the constructs, relationships and indicators met the criteria for consensus and/or stability.

NO FURTHER ROUNDS ARE REQUIRED.

All of the data from the Round Two questionnaire of the validation of the Mass Casualty Conceptual Model (MCCM©) has been analyzed and is available for your review on the study web page (www.u.arizona.edu/~jculley) under the ROUND TWO FEEDBACK link.

All of the data, including the very detailed comments that you provided, were reviewed and synthesized. The model was revised to reflect not only the rating responses to each question but to incorporate the wonderful comments that you made. The revised Mass Casualty Model (MCCM) is included in this link.

The Round 2 Feedback link also includes data related to your rating of the usefulness of the model to the further study of information and technology requirements during mass casualty events. Summary responses related to your rating of the usefulness of the online process used in the study are also presented.

I know that this was a very tedious process and I am most grateful for your valuable time in helping to provide the initial validation of the Mass Casualty Model (MCCM). Data from this study will be used as the foundation in my program of research to study the contributions that each of this constructs makes to outcomes during mass casualty events.

If you would like access to my dissertation please send me an email and I would be pleased to make the dissertation available to you. I believe this is incredibly important work and I am so grateful for your interest in this study. Please let me know if you have any further questions or comments.

Thank you for your valuable time in helping with this research. Your opinions and comments are greatly appreciated.

Very Respectfully,
Joan Culley
(H) 413-256-8786
Email: jculley@nursing.umass.edu
SUMMARY OF RESPONSES TO ROUND TWO OF THE VALIDATION OF THE MASS CASUALTY CONCEPTUAL MODEL (MCCM)

The following summarizes your responses to the second series of questions that concerned your opinions related to the importance of each construct, relationship and indicator as an appropriate predictor of outcomes of care during mass casualty events. The response rate was 81% or 13 out of 16 expert panel members responded to Round Two. ALL OF THE CONSTRUCTS, RELATIONSHIPS AND INDICATORS MET THE CRITERIA FOR CONSENSUS AND/OR STABILITY. NO FURTHER ROUNDS ARE REQUIRED.

All of the data was synthesized to modify the model. The revised Mass Casualty Model (MCCM) is also included in this link.

Summary information includes:

- Histograms that summarize the number of respondents that rated each construct and relationship in Round Two as:
  - 1 Not Important to 7 Critically Important.
- Tables that summarize:
  - The median response for each construct and relationship for each round.
  - The scale points for each round. Less than one scale point is required to reach consensus.
  - Percent Stability between Round One and Round Two. Less than 15% is required to reach stability between rounds.
  - Indications if consensus and/or stability were reached about the importance of each construct.
- Histograms that summarize the percent agreement among respondents that rated each indicator or measure for each construct in Round Two as:
  - 1 Delete 2 Modify 3 Retain.
- Tables that indicate the percent agreement for each indicator for both rounds.
  - Percent agreement of 70% or greater is required to reach consensus.
  - Percent Stability between Round One and Round Two. Less than 15% is required to reach stability between rounds.
  - Indications if consensus and/or stability were reached about the importance of each construct.
- Any comments included by respondents related to constructs, relationships or indicators.
- A histogram that summarize the number of respondents that rated the importance of the model to the further study of information and technology requirements during mass casualty events as:
  - 1 Not Important to 7 Critically Important
- A table that indicates the mean response for rating of importance of the model to the further study of information and technology requirements during mass casualty events. A histogram that summarizes the number of respondents that rated the usefulness of each component of the Delphi Process as:
• 1 Not Important to 7 Critically Important
• The mean response for the rating of usefulness for each component of the online Delphi process.
• Comments related to the importance of the model or the online Delphi process.
Example Construct Related to Organizational Customs Indicates:

- 0 respondents rated Organizational Customs as 1 or not important
- 2 respondents rated Organizational Customs as 2
- 0 respondents rated Organizational Customs as 3
- 3 respondents rated Organizational Customs as 4
- 2 respondents rated Organizational Customs as 5
- 3 respondents rated Organizational Customs as 6
- 3 respondents rated Organizational Customs as 7 or critically important
**CONSTRUCTS**

Table 1: Median Responses from 1 = Not Important to 7 = Critically Important, Spread of Scale Points, and Status of Consensus/Stability Related to the Ten Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Median Response Round 1</th>
<th>Median Response Round 2</th>
<th>Spread of Scale Points Round 2</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs</td>
<td>5.5</td>
<td>5.0</td>
<td>2.0</td>
<td>1.2%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Triage Unit</td>
<td>6.0</td>
<td>6.0</td>
<td>1.0</td>
<td>-6.0%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>Organizational Complexity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Context</td>
<td>6.0</td>
<td>6.0</td>
<td>2.0</td>
<td>-0.3%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Patients</td>
<td>6.0</td>
<td>6.0</td>
<td>1.0</td>
<td>7.9%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>Workforce</td>
<td>6.0</td>
<td>6.0</td>
<td>1.0</td>
<td>7.9%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>Information Technology</td>
<td>5.0</td>
<td>5.0</td>
<td>2.0</td>
<td>6.0%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Structure</td>
<td>5.0</td>
<td>5.0</td>
<td>2.0</td>
<td>-4.8%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Triage</td>
<td>6.0</td>
<td>6.0</td>
<td>1.0</td>
<td>3.6%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>Outcomes</td>
<td>6.0</td>
<td>6.0</td>
<td>1.5</td>
<td>-2.6%</td>
<td>Stability Met to Retain</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when \( \leq 1 \) Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**

Identify and define any additional construct(s) that in your opinion is needed to adequately predict the outcomes of care during mass casualty events.

- I was wondering about equipment?
I agree with the round 1 comment below (Community Disaster preparedness plans: The level of preparedness planning initiated prior to the event including the number of drills and exercises (needed to identify the extent of material resources and staff needed to respond to either real or imagined events). I also agree with the comment below from round 1: • Political environment: From a US national sense this would include factors such as current support, or lack there of in governmental leaders; how politically charged is the event (i.e.9/11 or Pearl Harbor vs. the poor, black citizens of New Orleans); perhaps there is also an element of the level of corruption in the response agencies (i.e. leaders who are political

• Resources..medical supplies.....medical support...transportability....

Recommend any additional changes to the constructs that in your opinion are needed to adequately predict the outcomes of care during mass casualty events.

I agree with the comments below from round 1: The ability of personnel to effectively utilize existing technology, experience with equipment, knowledge of key forms, and known rate of work. • mid-range and long-term outcomes should be added as mentioned in earlier item • Community Disaster Plans (pre-planning) • Training should be an actual construct(s). I don't agree however that they are strategically much more important to the outcome of any MCI than Information Technology, Triage and Resources and rather than being more highly placed than it is in the Workplace Construct it should have equal weight. • The quality, methodology and frequency of exercises can provide strong data point to help predict the outcome of care during a mass casualty event.

• Outcomes cannot be a predictor of outcomes. This area needs to be consolidated with either patients or triage

• I continue to assert that outcomes cannot be a predictor of outcomes.

• Resources....how much of what is available, where can re-supply come from. This construct clearly influences patient outcomes. If we don't have enough IV solution.....pt outcome will be effected.
Example: Constructal Relationship Related to Organizational Customs as an Influence on the Informational Technology Environment Indicates:

- 0 respondents rated Organizational Customs as 1 or not important
- 3 respondents rated Organizational Customs as 2
- 3 respondents rated Organizational Customs as 3
- 2 respondents rated Organizational Customs as 4
- 2 respondents rated Organizational Customs as 5
- 2 respondents rated Organizational Customs as 6
- 1 respondent rated Organizational Customs as 7 or critically important
## RELATIONSHIPS

Table 2: Median Response from 1 = Not Important to 7 = Critically Important, Spread of Scale Points, and Status of Consensus/Stability Related to Relationships

<table>
<thead>
<tr>
<th>Construct Relationships</th>
<th>Median Response Round 1</th>
<th>Median Response Round 2</th>
<th>Spread of Scale Points Round 2</th>
<th>Stability % change from Round 1</th>
<th><em>Status of Consensus/Stability</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs as an influence on the Information Technology environment</td>
<td>5.0</td>
<td>4.0</td>
<td>2.0</td>
<td>-9.9%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Triage Unit Organizational Complexity as an influence on the Information Technology environment</td>
<td>4.5</td>
<td>4.0</td>
<td>2.0</td>
<td>-3.4%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Environmental Context as an influence on the Information Technology environment</td>
<td>5.0</td>
<td>5.0</td>
<td>3.0</td>
<td>-6.6%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Patients as an influence on the Information Technology environment</td>
<td>5.0</td>
<td>5.0</td>
<td>3.3</td>
<td>1.3%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Resources as an influence on the Information Technology environment</td>
<td>5.5</td>
<td>5.5</td>
<td>1.0</td>
<td>10.0%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>Workforce as an influence on the Information Technology environment</td>
<td>6.0</td>
<td>5.0</td>
<td>1.0</td>
<td>-1.0%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>Information Technology as an influence on the fit to Structure</td>
<td>5.0</td>
<td>5.0</td>
<td>1.5</td>
<td>-1.0%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Structure as an influence on Triage</td>
<td>5.5</td>
<td>5.5</td>
<td>2.3</td>
<td>2.8%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>Triage as an influence on Outcomes</td>
<td>6.0</td>
<td>7.0</td>
<td>1.0</td>
<td>2.3%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
</tbody>
</table>

*Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1
COMMENTS:
Identify and define any additional relationship(s) that in your opinion is needed to adequately assess the continuum of care during mass casualty events.

None

Recommend any additional changes in the relationships that in your opinion are needed to adequately provide valid representation of the continuum of care during mass casualty events.

- Community Disaster Plans influence all of the constructs
- Information/Technology shouldn't be mixed. The definition being used for Technology seems too broad.
- Triage is an influence on outcomes, so I want to check 'critically important' but that is not the case for the current material under 'outcomes'; rather it applies to the overall process leading to patient outcomes.
Example: Organizational Customs Indicators Show:

- 30.8% of respondents indicated to DELETE the shared beliefs related to the prioritization categories for triage
- 7.7% of respondents indicated to MODIFY the shared beliefs related to the prioritization categories for triage
- 61.5% of respondents indicated to RETAIN the shared beliefs related to the prioritization categories for triage
**INDICATORS FOR EACH CONSTRUCT**

Table 3: Percent Agreement Related to Indicators for Organizational Customs Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Customs Indicators</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
</tr>
<tr>
<td>a. Shared beliefs related to prioritization categories for triage</td>
<td>38%</td>
<td>31%</td>
<td>6%</td>
<td>7%</td>
<td>56%</td>
</tr>
<tr>
<td>b. Life cycle related to growth and stability of the organization</td>
<td>19%</td>
<td>15%</td>
<td>31%</td>
<td>39%</td>
<td>50%</td>
</tr>
<tr>
<td>c. Incentive structure related to punishment/rewards and feedback</td>
<td>31%</td>
<td>46%</td>
<td>6%</td>
<td>8%</td>
<td>63%</td>
</tr>
</tbody>
</table>

*Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1*

**COMMENTS:**

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

- Triage prioritization needs to be clear and understandable. I'm not sure belief is the correct term. If I clearly understand and can apply an organizational triage prioritization, pt outcome will be effected.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

- I agree with one of the previous submitted comments that punishment/reward and feedback don't really apply to a MCI situation.
- Belief in the organizations triage methodology. I can not agree with a triage methodology, but still work as part of a team during a mass cas event. True emergency responders work under these situations on a daily basis.
INDICATORS FOR EACH CONSTRUCT

Table 4: Percent Agreement Related to Indicators for Triage Unit Organizational Complexity Construct, Percent Stability, and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus /Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triage Unit Organizational Complexity Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Number of specialties in workforce</td>
<td>13%</td>
<td>18%</td>
<td>20%</td>
<td>18%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>b. High tech nature of the organization</td>
<td>21%</td>
<td>20%</td>
<td>36%</td>
<td>60%</td>
<td>Stability Met to Modify</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- I agree with the round comments below: More emphasis needed on skill mix vs. "specialties in workforce"; for example, a cadre of general volunteers might prove more valuable than specialists in many situations. • Did you combine tech readiness with high tech? According to page 3 of your powerpoint they were two separate indicators but weren't listed so above. Confusing. I think they should be combined into technology abilities as the indicator
- Knowledge and experience as an organization in events

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- I agree with all of the round 1 comments below: Recommend editing 'high tech nature of organization' to 'technological sophistication of organization'. • I think "high tech nature of the organization" needs to be clarified. • Cross-train certain specialties and support staff so that number individuals with certain specialties can be reduced thereby possibly reducing then number workforce members. • Every incident is going to call upon different people to work together, through mutual aid agreements and tours/shifts. Any team has to be able to adapt, and it will always be different personnel especially when you are talking about Volunteer and Call fire departments. Technology, specialties etc. are fine for bigger departments that have specialized people, but the greatest number of responding
agencies are small, and this is too complex for the majority. We need to train the greatest number of people in a way that they will easily understand. • High Tech- triage algorithms exist that define treatment procedures. Team members should be "proficient" in the triage/treatment modalities. There should be no un-familiar procedures. In relation to new threats (i.e. anthrax)...the proficiency of the team in these new threat responses can have an affect on patient outcome. Team Culture- I don't think the term is used appropriately. Consistent and standardized training can develop a team synergy that produces positive patient outcomes. Exercising....I feel strongly that exercising needs to be incorporated in the model....possible within this section.

- Number, proportion and relevance of specialties in the workforce (having 5 specialties, but 4 of them totally irrelevant to the event is less useful than having only 2 specialties, but in sufficient numbers to make a different.
- Though the high tech nature of an organization can be an indicator, I feel you need to expand this construct. I've worked with agencies that would be considered "low tech" and have seen results from these organizations that parallel with "high tech" organizations.
ENVIRONMENTAL CONTEXT INDICATORS PERCENT AGREEMENT

RESPONSES

Setting (rural or urban)

PERCENT (%)
## Indicators for Each Construct

Table 5: Percent Agreement Related to Indicators for Environmental Context Construct, Percent Stability, and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Context Indicators</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
</tr>
<tr>
<td>Setting (rural or urban)</td>
<td>19%</td>
<td>23%</td>
<td>25%</td>
<td>15%</td>
<td>56%</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

- Suburban?
- I agree with the round 1 responses below: • As noted, discuss inclusion of suburban • Level of disaster (i.e. state, regional, national, international) • Urban and rural are too gray. Training as to be an integral part of all these constructs. • Weather In an intentional anthrax release, wind patterns can affect how a response is initiated. Snowy conditions can affect the patient outcomes during a mass casualty event.
- I've thought of another environmental factor that provided highly significant in New Orleans after Katrina: the organizational/financial structure of the facility. The hospitals in NO that survived credit their role in a larger health system with their success (e.g., Tulane Univ. Hospital). These hospitals had people assisting them outside the devastated area - and they had additional financial resources unlike stand alone hospitals like Charity. This indicator might be called membership in health system.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

- I agree with the round 1 comments below: categorize disasters as natural, unintentional or deliberate most disaster experts assert, that a disaster is the effect of an agent or event on a vulnerable human society. Therefore the disaster
is not the tornado or flood - but the disrupted human social system. Additional references: “A disaster happens when an extreme event occurs in the context of societal vulnerability.” Pielke RA. (2006) Ocenaography 19: 2 “Disasters Death, and Destruction. Making Sense of Recent Calamities pp 138-247 broaden these and reconsider your conceptualization. If you conceptualize disaster as a social disruption, power loss is one indicator of a disaster but hurricane (only one type of windstorm) and flood are the CAUSE of the disaster. Your list of disasters is missing volcano, extreme temperature events, slides (mud earth, etc.), wildfire, and earthquake. You may want to look at how CRED categorizes disasters at http://www.cred.be/ • Why are rural or urban important...they are not universally defined the same way. Rural in New England is quite different than Arizona

- I think the rural/suburban/urban setting is less important that other factors including proximity to the disaster and distance to other health facilities.
INDICATORS FOR EACH CONSTRUCT

Table 6: Percent Agreement Related to Indicators for Patient Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus /Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Indicators</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td></td>
</tr>
<tr>
<td>a. Demographics</td>
<td>19%</td>
<td>0%</td>
<td>25%</td>
<td>15%</td>
<td>56% 85% 19.8% Consensus Met to Retain</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

- My comments R/T round 1 comments • What about care for those who had existing disabilities and chronic disease? Superimposed with a disaster they will no longer be coping effectively and need help. Same with needs for pregnant and nursing women and children - few if anyone functions effectively during and after a disaster weather you have a disability or not. The issue is to effectively plan for and meet all victims' needs demographics are not important factors when we respond to an incident. Age and gender are not something we should take into consideration - I strongly disagree as the glossary defines demographics also including contributing "health" conditions with the following references to R/T older adults with existing conditions as an example: “Older adults who have a condition that affects their independence and places them at future risk of needing a higher level of care than is currently required.” http://www.211taxonomy.org/search/record?code=YF%2d200 Last accessed 4/9/07 AIRS/INFO LINE Some of the conditions affecting the frail elderly and the impact on their ability to respond to disasters are described below. Sensory deprivation can cause alterations in sense of smell, touch, vision, and hearing that can result in an impaired ability to identify spoiled food, not hearing or seeing warnings or instructions. Delayed sensory and cognitive response slows motor activity and causes difficulty in comprehension affecting evacuation capabilities. Chronic conditions such as arthritis affect stamina and the ability to stand in line. Many medications can cause confusion and impaired ability to follow directions as well as the urgent need to reestablish medication regimens. Susceptibility to dehydration and hypo/hyperthermia result in the inability to tolerate delays in evacuation and medical attention. Transfer trauma leading to disorientation and distress require special attention to suitable
residential relocation and the need for face-to-face contact with older adults in their natural environments especially for isolated in their own homes. Stigma and unfamiliarity with bureaucracy, language and cultural barriers affect the ability of the frail elderly to seek and obtain assistance. The elderly are at high risk for disorientation and extended emotional effects. Oriol W. Editor Nordboe D. (1999) Psychosocial Issues for Older Adults in Disasters Editor Portland Ridley. Emergency Services and Disaster Relief Branch, Center for Mental Health Services (CMHS), Substance Abuse and Mental Health Services Administration. Nutr Rev. 2005 Jun;63(6 Pt 2):S22-9. Strategies for ensuring good hydration in the elderly. Ferry M. Centre Hospitalier Universitaire, Service de Geriatrie, 179 Blvd. du Marechal Juin, F-26953 Valence 9, France. mferry@ch-valence.fr http://heartspring.net/water_thirst_electrolytes_elderly.html Last retrieved 4/10/07 • I would recommend you make one category "Patient Variability" that would include injury type, number, demographics etc.

- Demographics are vital to consider in this model. If a facility has a large number of pediatric, geriatric or other group of victims and lacks appropriate plans and caregivers, care quality will be degraded.

**Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.**

- I support this statement from round 1: Strongly recommend changing the use of 'medical' conditions' to 'health' conditions
Availability of resources in each category

RESOURCE INDICATORS PERCENT AGREEMENT

1 = DELETE    2 = MODIFY    3 = RETAIN
## Table 7: Percent Agreement Related to Indicators for Resource Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus /Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Indicators</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td></td>
</tr>
<tr>
<td>a. Availability of resources in each category</td>
<td>0%</td>
<td>0%</td>
<td>33%</td>
<td>0%</td>
<td>67%</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

None

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

None
**INDICATORS FOR EACH CONSTRUCT**

Table 8: Percent Agreement Related to Indicators for Workforce Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Credentials/Licenses</td>
<td>Round 1: 12%, Round 2: 0%</td>
<td>Round 1: 25%, Round 2: 8%</td>
<td>Round 1: 63%, Round 2: 92%</td>
<td>16.7%</td>
<td>Consensus Met to Retain</td>
</tr>
<tr>
<td>b. Experience with technology</td>
<td>Round 1: 13%, Round 2: 8%</td>
<td>Round 1: 31%, Round 2: 17%</td>
<td>Round 1: 56%, Round 2: 75%</td>
<td>9.4%</td>
<td>Consensus and Stability Met to Retain</td>
</tr>
<tr>
<td>c. Skill mix</td>
<td>Round 1: 19%, Round 2: 8%</td>
<td>Round 1: 25, Round 2: 33%</td>
<td>Round 1: 56%, Round 2: 59%</td>
<td>5.3%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>d. Education</td>
<td>Round 1: 12%, Round 2: 8%</td>
<td>Round 1: 25%, Round 2: 25%</td>
<td>Round 1: 63%, Round 2: 67%</td>
<td>3.3%</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>e. Needs related to safety and health</td>
<td>Round 1: 0%, Round 2: 17%</td>
<td>Round 1: 31%, Round 2: 17%</td>
<td>Round 1: 69%, Round 2: 66%</td>
<td>-7.0</td>
<td>Stability Met to Retain</td>
</tr>
<tr>
<td>f. Age</td>
<td>Round 1: 47%, Round 2: 70%</td>
<td>Round 1: 47%, Round 2: 15%</td>
<td>Round 1: 6%, Round 2: 15%</td>
<td>-8.7%</td>
<td>Consensus and Stability Met to Delete</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**

Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.

- I strongly agree with the following comments from round 1: Strongly encourage revising 'needs related to safety and health' to 'willingness to work'. A body of science is emerging that indicates health care personnel may not be willing to work in all disaster situations. Concerns about health and personal safety are only two of the reasons - others include concern for pets and family members, fear, etc. • Perhaps physical health, disability and handicap should be considered somewhere in the mix. • Estimated service time - ie how long workforce is expected to serve and in what shifts
• Recommend changing 'needs related to safety and health' to 'willingness to work in disaster.'
• Confidence in their leadership.

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.

• I agree with this comment from round1: Is there overlap in education/credentials/licensure as separate indicators? I am questioning whether age is a meaningful indicator of maturity in mass casualty event, I prefer experience.
• Credentials/licenses should cover the educational issue; the impact of age is too variable to be useful.
• Modify skill mix.....a diverse response is essential during a mass cas event. Competencies in their skills.....diverse and competent is the key here.
INFORMATION TECHNOLOGY: TECHNOLOGY INDICATORS PERCENT AGREEMENT

Characteristics related to ergonomics, functionality and amount

Work Flow

Rate of Flow

PERCENT (%)

1 = DELETE  2 = MODIFY  3 = RETAIN
### INDICATORS FOR EACH CONSTRUCT

Table 9: Percent Agreement Related to Indicators for Information Technology (Technology) Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology (Technology Indicators)</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
</tr>
<tr>
<td>a. Characteristics related to ergonomics, functionality and amount</td>
<td>20%</td>
<td>23%</td>
<td>33%</td>
<td>38%</td>
<td>47%</td>
</tr>
<tr>
<td>b. Work Flow</td>
<td>13%</td>
<td>8%</td>
<td>20%</td>
<td>23%</td>
<td>67%</td>
</tr>
<tr>
<td>c. Rate of Flow</td>
<td>13%</td>
<td>8%</td>
<td>20%</td>
<td>15%</td>
<td>67%</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**
- I agree with the comments below from round 1: What about power needs? What about Internet availability? What about connections to other servers etc. • Multiple ways to access and process, and share data even when power and towers are down. • Determining the type of data that will need to be collected will be event driven. There are basic demographic points, but during a BT event minimal demographic points might be the only data that can be collected due to the nature of the disease/event.
- **Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.**
- I am still a bit unclear on work flow and rate flow.
INFORMATION TECHNOLOGY: INFORMATION INDICATORS PERCENT AGREEMENT

- Terminology: Security Characteristics related to: currency, access, format(s), amount, usability, and completeness
- Responses:
  - Terminology: 16.7% DELETE, 16.7% MODIFY, 66.7% RETAIN
  - Security: 23.1% DELETE, 23.1% MODIFY, 53.8% RETAIN
  - Characteristics related to: currency, access, format(s), amount, usability, and completeness: 7.7% DELETE, 0.0% MODIFY, 92.3% RETAIN
## INDICATORS FOR EACH CONSTRUCT

Table 10: Percent Agreement Related to Indicators for Information Technology (Information) Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology (Information Indicators)</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
</tr>
<tr>
<td>a. Terminology</td>
<td>0%</td>
<td>17%</td>
<td>31%</td>
<td>17%</td>
<td>69%</td>
</tr>
<tr>
<td>b. Security</td>
<td>12%</td>
<td>23%</td>
<td>25%</td>
<td>23%</td>
<td>63%</td>
</tr>
<tr>
<td>c. Characteristics related to: format(s), amount, usability, and completeness</td>
<td>14%</td>
<td>8%</td>
<td>21%</td>
<td>0%</td>
<td>65%</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
None
Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
None
Structure or the degree of hierarchical to flexible organization needed. This is dependent upon spatial integration or lines of communication and feedback loops.
INDICATORS FOR EACH CONSTRUCT

Table 11: Percent Agreement Related to Indicators for Structure Construct, Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus /Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure Indicators</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td></td>
</tr>
<tr>
<td>a. Structure or the degree of mechanistic (bureaucratic) to organic organization needed. This is dependent upon spatial integration or lines of communication and feedback loops.</td>
<td>7%</td>
<td>0%</td>
<td>33%</td>
<td>31%</td>
<td></td>
</tr>
</tbody>
</table>

* Consensus is satisfied when \( \leq 1 \) Scale Point; Stability is satisfied when \(<15\%\) change from Round 1

COMMENTS:
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- Still not clearly defined... choose "lines of communication" over "spatial integration"

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
- Critical to add 'ability of organization to improvise'.

Consensus and Stability Met to Retain
OUTCOMES: PATIENT INDICATORS PERCENT AGREEMENT

<table>
<thead>
<tr>
<th>RESPONSES</th>
<th>PERCENT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival</td>
<td>11.1</td>
</tr>
<tr>
<td>Disability</td>
<td>11.1</td>
</tr>
</tbody>
</table>

- 88.9% agreement for Both

1 = DELETE
2 = MODIFY
3 = RETAIN
## INDICATORS FOR EACH CONSTRUCT

Table 12: Percent Agreement Related to Indicators for Outcome Construct (Patient), Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Retain</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome Indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Patient Outcomes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Survivability</td>
<td>Round 1: Not asked</td>
<td>Round 2: 11%</td>
<td>Round 1: Not asked</td>
<td>Round 2: 0%</td>
<td>Round 1: Not asked</td>
</tr>
<tr>
<td>b. Disability</td>
<td>Round 1: Not asked</td>
<td>Round 2: 11%</td>
<td>Round 1: Not asked</td>
<td>Round 2: 0%</td>
<td>Round 1: Not asked</td>
</tr>
</tbody>
</table>

* *Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1*

### COMMENTS:

- Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
  - Death
  - The most important indicator was: Were the victims' needs met (did they get their medications in a reasonable time frame, was the dialysis unit able to treat them in a reasonable time frame)

- Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
  - None
Outcomes: Resource Indicators Percent Agreement

Overtriage – overestimate of injuries and over treatment resulting in the inappropriate use of limited resources
**INDICATORS FOR EACH CONSTRUCT**

Table 13: Percent Agreement Related to Indicators for Outcome Construct (Resources), Percent Stability and Status of Consensus/Stability

<table>
<thead>
<tr>
<th>Construct Indicator</th>
<th>1 Delete</th>
<th>2 Modify</th>
<th>3 Delete</th>
<th>Stability % change from Round 1</th>
<th>*Status of Consensus/Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome Indicators (Resources Outcomes)</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
<td>Round 2</td>
<td>Round 1</td>
</tr>
<tr>
<td>a. Overtraige</td>
<td>13%</td>
<td>8%</td>
<td>20%</td>
<td>8%</td>
<td>67%</td>
</tr>
</tbody>
</table>

* Consensus is satisfied when ≤ 1 Scale Point; Stability is satisfied when <15% change from Round 1

**COMMENTS:**
Identify and define any additional indicator(s) that in your opinion is needed to adequately measure this construct.
- Death

Recommend any additional changes to the indicators that in your opinion are needed to adequately measure the construct.
  - None
USEFULNESS OF THE MODEL IN FURTHER RESEARCH

Rate the usefulness of the model

RESPONSES

1 = NOT IMPORTANT
2
3
4
5
6
7 = CRITICALLY IMPORTANT
USEFULNESS OF THE MODEL IN FUTURE RESEARCH

Table 14. Mean Response from 1 = Not Important To 7 = Critically Important Related to the Usefulness of the Model to the Further Study of Information and Technology Requirements During Mass Casualty Events

<table>
<thead>
<tr>
<th>Usefulness of the Model</th>
<th>Mean Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.3</td>
</tr>
</tbody>
</table>

COMMENTS:
Please include any addition comments regarding the usefulness of the model:
- Depends on consensus among the (hopefully) wide range of respondents; if Incident Commanders, Nurses, Emergency Responders, and Technical providers all see the model as something they can build on, then it is a success. If one Essential Party declares it as not useful, then the model will have a quirk, because all need to be involved.
- The model would be useful in the study of IT utilized during Mass Casualty events but IT need not be present to have successful triage!
- This is a sophisticated model that captures complex elements in a logical manner.
- I look at this model from a few different perspectives. As a nurse, the model seems to be a bit "expanded". Yes there are factors and conditions that will effect patient outcome...but in today's response world, Management Systems are being created and utilized to increase positive patient outcomes during a mass casualty event. I do believe resources, that include the workforce, need to be competent and available.....this two factors, in my opinion are the greatest factors. We need the right people and have available the right resources available.
USEFULNESS OF ITEMS IN THE ONLINE DELPHI PROCESS

- 1 = NOT IMPORTANT
- 2
- 3
- 4
- 5
- 6
- 7 = CRITICALLY IMPORTANT

RESPONSE RATINGS

- Webpage
- Narrated Instructions about the Delphi Process
- Narrated Explanation of the MCCM
- Online Glossary
- Online Questionnaires
- Online feedback

Respondents (number)
USEFULNESS OF THE ONLINE DELPHI PROCESS

Table 15: Mean Responses From 1 = Not Important To 7 = Critically Important Related to the Usefulness of the Online Processes Used in the Study

<table>
<thead>
<tr>
<th>Online Processes Used in the Study</th>
<th>Mean Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webpage</td>
<td>6.0</td>
</tr>
<tr>
<td>Narrated Instructions about the Delphi Process</td>
<td>5.5</td>
</tr>
<tr>
<td>Narrated Explanation of the MCCM</td>
<td>6.2</td>
</tr>
<tr>
<td>Online Glossary</td>
<td>6.4</td>
</tr>
<tr>
<td>Online Questionnaires</td>
<td>6.1</td>
</tr>
<tr>
<td>Online feedback</td>
<td>6.2</td>
</tr>
</tbody>
</table>

COMMENTS:

- It was difficult to flip back and forth between the comments and the second round questions. Place the comments directly with the round 3 questions. We can cut and paste or indicate which comments we agree with or would like to expand on.
- The variability in computers made the slides for the model narration difficult to follow. There were no control bars that allowed for moving ahead or backing up, at least as I was able to access it.
- Not to be picky...the font was a bit small. I would list the numbers above the columns....with the terms "not useful"....all the way up to "very useful". #s might mean different things to different people
REFERENCES


Sundnes, K.O., & Birnbaum, M.L. (Ed.) (2003). Guidelines for evaluation and research in the Utstein style [Volume 17(Supplement Number 3)]. *Journal of Pre-Hospital and Disaster Medicine.*


