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A Model to Advance Nursing Science in Trauma Practice and Injury Outcomes Research

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Abstract

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Background: The continuum of clinical care provided to trauma patients extends from the time of injury through to long-term recovery and final outcomes. Nurses bring a unique expertise to meet the complex physical and psychosocial needs of trauma patients and their families to influence outcomes across this entire continuum.

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Discussion: Core concepts in this trauma outcomes model include environment, person/family, structured care settings, long term outcomes and nursing interventions. The relationships between each of these concepts extend across all phases of care. Intermediate outcomes are achieved in each phase of care and influence and have congruence with long term outcomes.

Implications for Policy and Practice: This model is intended to provide a framework to assist trauma nurses and researchers to consider the injured person in the context of the social, economic, cultural and physical environment from which they come and the long term goals that each person has during recovery. The entire model requires testing in research and assessment of its practical contribution to practice.

Conclusion: Planning and integrating care across the trauma continuum, as well as recognition of the role of the injured person's background, family and resources, will lead to improved long term outcomes.

Keywords

Conceptual model, trauma, nursing, health outcomes, injury outcomes

Disciplines

Medicine and Health Sciences | Nursing

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What is already known about this topic:

- Trauma care is delivered in multiple settings across a time continuum
- Recovery following injury often continues for months or years
- Trauma nurses are optimally placed to improve the communication and integration of patient care across the continuum

What this paper adds:

- Articulation of the settings in which trauma care is delivered and the linkages between those settings
- Identification of the long term goals of trauma care and the associated nursing priorities
- Description of the relationship between the intermediate outcomes achieved in each care setting and the long term goals

Implications for practice and/or policy:

- Provides trauma nurses clear direction on why and how to think about care beyond their specific setting
- Proposes a model and underlying theoretical assumptions to inform research to build knowledge in trauma nursing which will help improve the evidence-base for practice

- In this model, we strongly suggest that trauma care cannot be viewed as distinct episodes of care but must be conceptualized across the time/space continuum

INTRODUCTION

Injury is a significant health problem across the lifespan, ranking in the top ten causes of death currently and projected to become the 4th leading cause of disability adjusted life years by 2030 globally (Mathers et al. 2009, Mathers & Loncar 2006). Injury is caused by a variety of mechanisms, but whatever the cause, the common endpoint is damage to cells, tissues, and organs due to the transmission of external forces to the body. Severity of injury is categorized as minor, moderate, serious and incompatible with life. The terms injury and trauma are often used interchangeably but the term trauma is typically used when referring to more serious injuries. Scoring systems such as the Injury Severity Score (Baker et al. 1974) and the Revised Trauma Score (Champion et al. 1989) are widely used to both describe type and severity of injury and predict mortality. Because of the life-threatening nature of injury where time to treatment is important, trauma systems have developed over the past three decades. These trauma systems encompass broad geographical areas and/or smaller areas with high population density, with trauma-dedicated services established within designated acute hospital facilities leading to reduced mortality (Nathens et al. 2000, Peleg et al. 2004).

Providers and patients alike indicate that a sole focus on injury survival as the dominant outcome is insufficient. Instead, return to previous level of function and reintegration into pre-injury lifestyle, such as return to family, community, education, work, leisure, or retirement activities are recognised as important

outcomes of trauma care. These outcomes are not immediate and can take years to achieve. Up to half of all patients report compromise in functional, quality of life (QOL), psychological and economic aspects of recovery. Injured cohorts in Europe, the USA, and Australia report incomplete recovery with 18 – 65% of patients reporting limitations in self-care, mobility, pain and discomfort and cognitive complaints (Holtslag et al. 2007, O'Mullane et al. 2009). Only 55% of trauma patients achieve maximum function even at 3 year's post-injury (Livingston et al. 2009). Health-related QOL is lower for trauma patients 18 months after injury compared with the general population norm; problems include delusional memories (Ringdal et al. 2009) and injury related pain (Rivara et al. 2008). Similarly, 10 - 20% of injured patients report Post Traumatic Stress Disorder and up to 18% report depression 12 months post-injury (O'Donnell et al. 2004, Richmond et al. 2009, Zatzick et al. 2008).

Financial problems are reported, both in terms of expenditures required for ongoing health service utilisation and inability to return to work and earn an income. In a Canadian cohort, those recovering from injury used more health services every year for 10 years post-injury than a non-injured comparative group (Cameron et al. 2006). Similarly, Gabbe et al. (2007) found 69% of a major injury cohort continued to require health services six months after hospital discharge. Some patients required more than 12 months before they were able to return to work (O'Donnell et al. 2005, Shults et al. 2004, Soberg et al. 2007), with only 43% of

a cohort of 100 Norwegian injured patients having returned to work at 2 years (Soberg et al. 2007).

These descriptions of long term recovery help us understand what aspects of function remain compromised, however to improve long term recovery it is essential that we consider what factors affect this recovery. While scoring systems such as the Injury Severity Score and the Revised Trauma Score predict mortality, they do not effectively predict post-injury functional recovery in the general trauma population (Richmond et al. 1997, Richmond et al., 1998). Yet, there is evidence that patients with compromised recovery can be identified at the time of acute hospitalization by other risk factors. Demographic variables such as pre-injury education and employment (Connelly et al. 2006), treatment factors such as sedation and analgesia management (Samuelson et al. 2006), admission to the intensive care unit (ICU) (Connelly et al. 2006, O'Donnell et al. 2010) pre-injury function (Richmond 1997), family involvement (Mitchell et al. 2009) and acute psychological distress (Richmond et al. 2003) have been identified as predicting short and long term recovery. Identification of factors that are related to long term recovery enable interventions across the continuum of trauma care to be individually tailored to optimize recovery. The barrier however, is that systems of nursing care are isolated from one another – with trauma patients cared for in pre-hospital settings, acute care hospitals, rehabilitation settings, and in the community. Given these structural issues, nurses typically focus on achieving immediate outcomes relevant to their setting (e.g., resuscitation or critical care

within the acute care setting) without carefully considering the important long-term outcomes of trauma care.

BACKGROUND

Trauma nursing as a specific term has been used in varied ways in the literature. In this paper we refer to trauma nursing as the care provided to injured patients by professional nurses who are members of the multidisciplinary team. Nurses provide care of trauma patients across nursing specialties, such as emergency, critical care, perioperative, medical-surgical, rehabilitative, and community nursing. As we will propose in the Trauma Outcomes Model, nurses in these specialties provide care and bring a unique expertise to meet the complex physical and psychosocial needs of trauma patients and their families that vary depending on the phase of care.

Descriptions of what constitutes trauma nursing have been limited. Although there are various descriptions of the trauma case manager role, (Cobb & Pridgen, 2008; Fraser & Curtis 2006, Griffith et al. 2001) these roles are limited to a single coordinating position within a trauma service rather than reflecting the role undertaken by all nurses caring for injured patients and consequently do not clarify the trauma nurse's role. Some aspects of the trauma nurse role can be drawn from the role responsibilities articulated by the American Association of Critical Care Nurses (AACN 2008). Pertinent responsibilities include helping the patient to obtain necessary care, monitoring and safeguarding the quality of that care, respecting the rights, values and beliefs of the patient and taking actions to ensure

other members of the healthcare team recognize these and acting as a liaison between the patient, family members and members of the healthcare team. Long and colleagues (2002) provide a complementary description of the nursing role which, although specific to the rehabilitation setting, applies well to the acute trauma setting. The interlinked roles in rehabilitation include assessment, coordination and communication, technical and physical care; integration and delivery of therapy; emotional support; involvement of the family and creation of a supportive environment (Long et al. 2002).

The nursing science that underpins the role of trauma nurses across the continuum of care is in its beginning stages, but represents an essential area of development. In considering the entire continuum nurses intervene in multiple ways including injury prevention, prevention of complications, optimization of acute care and its effect on recovery and reduction of the ongoing burden on injured individuals, their family, the health care system and society. No existing theoretical framework could be located that articulates the structured approaches and considerations required to care for the injured patient. Of relevance, current acute nursing care frameworks do not recognize fully the importance of pre-hospitalization factors such as the socio-demographic or injury characteristics, nor do they recognize the relationship between the intermediate outcomes achieved on discharge from the acute hospital, the post discharge processes and characteristics and the long term recovery of the patient.

Only one paper was found that addressed the care continuum over time and

place (Halcomb & Davidson 2005). These authors used the illness trajectory framework, originally proposed by Corbin and Strauss (1991) to describe recovery from injury. The strengths of their description include the long term approach to recovery, acknowledgement of the biopsychosocial impact of injury and recognition that pre-injury factors affect recovery. This framework acknowledges the inter-relationship of the actions of both the injured person and the health care team (Halcomb & Davidson 2005). The significant limitation is the lack of detail outlining the interventions that occur during both the acute and post-discharge phases of care and the relationship between the injured person, their family, interventions and recovery.

In this discussion paper, we report on the development of a model to advance nursing science and practice in trauma care based on an analysis of the literature and expert opinion. The authors bring decades of expertise in trauma care from two countries (United States, Australia) and lend that expertise, coupled with a systematic inclusion of the literature, to consider the limitations in our current systems of care. We propose to expand the well-known Quality Health Outcomes Model (Mitchell et al. 1998) that is widely used in health services research to create a model that crosses phases of care to better meet the needs of seriously injured trauma patients.

DATA SOURCES

Literature was obtained by searching CINAHL, PubMed and OvidMedline databases for the years 1990 – 2010. Search terms included “(trauma OR wounds

and injuries) AND nursing AND (scope of practice OR role) with results restricted to those published in English. Search terms were refined by initially finding a small number of relevant papers and determining the keywords that had been used in the referencing process for those papers. Searches identified 569, 1504, and 613 potential articles in CINAHL, PubMed, and OvidMedline respectively. Abstracts were reviewed to identify relevant papers. In addition, a manual search was undertaken of the *Journal of Trauma Nursing* since 2005. A targeted search was undertaken of the *Journal of Trauma* and *Injury* for nursing specific publications. Reference lists of included papers were reviewed to identify further relevant papers. Websites of professional organizations involved in trauma care were also searched for descriptions of scope of practice and educational content of relevant courses. A total of 57 papers were reviewed in full although only 32 of these were ultimately relevant to the development of this model. Each paper was carefully analyzed to determine relevance to the expansion of the QHOM and to verify or alter the key concepts proposed in the original QHOM. The quality of the evidence that was reviewed was generally low, with most papers being opinion pieces, discussion papers or retrospective analyses of trauma databases (Table 1).

PRESENTATION OF THE MODEL

The trauma model and foundational theoretical assumptions described in figure 1 are designed specifically to cross time and place, such that linkages inherent within specialties also cross phases of care. Indeed, the prevailing underlying assumption of the Trauma Outcomes Model is that only by explicating

the linkages across phases of care can long-term outcomes be enhanced and high quality trauma care be provided. Although long-term outcomes are not achievable during the acute phase of care, it is essential that these outcomes inform, and have congruence with, the intermediate goals set during acute care. It is also assumed that the desired outcomes and the interventions that are provided are driven by the needs of the injured person and his/her family. Below we define and discuss the concepts central to the model and their related theoretical linkages.

Concepts Central to the Model

The trauma model we present in this paper builds on the Quality Health Outcomes Model (QHOM), a widely used model built on structure, process, and outcomes, but in a non-linear manner (Mitchell et al. 1998). Since our proposed model is built on the QHOM, we start with its concepts and relationships. The QHOM has been widely validated in the clinical and research communities. In expanding this model, we subjected our trauma model and a draft of this manuscript to review by two of the QHOM developers (Dr. Pamela Mitchell and Dr. Bonnie Jennings) who also are experts in neurotrauma and trauma care in civilian and military sectors respectively. Final iterations of the trauma outcomes model were presented for critique and discussion at grand rounds at a Level I trauma center.

Core concepts from the QHOM are client, system, process, and outcome. We add a new concept – environment - as integral to this model and make explicit that the client concept is inclusive of patient and family. We expand the model to include

multiple and separate care systems that span pre-injury emergency care through to community reentry. We label these structured care systems. We acknowledge that the nursing interventions take place within each structured care system with system-specific outcomes, but we now expand outcomes to be inclusive of long-term outcomes. Relationships between these core concepts are made explicit as important underlying assumptions of the model (Table 2).

Environment. Trauma, a societal health problem, is directly and indirectly influenced by the environments of those societies. Because of variations in the social, economic, cultural, and physical environments the profile of injury mechanism and injury type within and across countries differs. Within countries, the environmental influence on trauma can be seen by the different injury profiles found in poor urban areas in the United States as compared with more rural areas (Barondess 2008, Branas et al. 2004). Differences are found across countries because of varying levels of development, cultural norms, or civil stability. Examples are many: a spike in traffic crashes in India where increasing numbers of motorcycles and cars are being used by the over billion population living in an unchanging landmass (Gururaj 2004); an increase in gun violence during the years following a country's civil unrest that leaves a large number of residual small arms (Cukier 2002); and rape and mutilation of women and girls in countries experiencing ethnic cleansing and civil unrest (Olujic 1998).

Environment affects quality and rapidity of trauma care delivery based on the structure, pre-hospital triage protocols, land characteristics (Danne 2003), and

whether care is civilian or wartime military (Colombo et al. 2008, Fang et al. 2008). Organised trauma systems (civilian or military) are directed by formal triage protocols to transport the injured to the appropriate level of care in the shortest time possible to reduce mortality and morbidity (MacKenzie et al. 2006, Eastridge et al. 2006). Both the absence of a system of care with triage protocols or the presence of a trauma system with large distances and areas with low population density resulting in longer transport times reduce the likelihood of rapid, definitive care, ultimately reducing the probability of achieving optimal long-term outcomes (Price et al. 2003). A military trauma system is one example of a setting where trauma care is provided across both large distances and multiple care settings throughout the trauma continuum (Fecura et al. 2008).

Other environmental factors (e.g. non-injury factors) influence post-discharge location and long-term outcomes. In the U.S., economics such as insurance coverage in conjunction with other social factors such as race, gender, and age can directly affect care and outcomes of injured patients. Variation in outcomes based on economic and social factors has been shown in disposition of trauma patients from the Emergency Department (ED) (Selassie et al. 2003), mortality (Haider et al. 2008) and discharge destination (Lim et al. 2007, Shafi et al. 2007). Similar variations have been shown in a cohort of spinal injury patients in Canada (Anzai et al. 2006) although limited examination of the issue outside the U.S. is reported. Other environmental factors can influence long-term outcomes, such as physical living structures and accessibility, access to public transportation in the community

and degree of instrumental social support. Attention to all relevant environmental factors is within the purview of nursing practice.

Person/Family. Each person brings to the injury a unique genetic profile, life trajectory, co-morbid conditions, substance use/abuse profile, and resources.

Classically, trauma has been considered a young person's disease; in developing countries this is true. However, many countries have a top-heavy population pyramid and in these countries an aging population translates into older injured patients with increasingly complex co-morbidities and physiologic needs (He et al. 2005).

Regardless of age, injured persons bring family structures that vary in composition and members who vary in beliefs, availability, and cohesion. As persons become 'patients' in an acute care setting, maintenance of their personhood within the context of the family system should be of top priority. Yet this, we posit, is almost diametrically opposed to acute trauma care systems where patients are often cared for in ICUs that restrict families by strict visitation policies. In the proposed trauma model, we argue that nurses and all trauma providers are the visitors in the lives of injured persons and their families and are privileged to care for them during this vulnerable post-injury time.

Persons' characteristics and environmental factors interact. For example, there is a known gradient of disability, where disability increases as socioeconomic status (SES) decreases (Minkler et al. 2006). Thus, nurses might anticipate that persons with lower SES are more likely to bring pre-existing disabilities to the

injury hospitalisation. Similarly, persons with substance abuse are at higher risk for an injury and will require additional resources to manage this co-morbid condition in addition to the injury (Manwell et al. 2005).

Structured Care Settings. Trauma care is provided within the structure of pre-hospital care, acute care hospitals, rehabilitation centres, and community health systems. The QHOM has been conceptualized primarily as a discrete organization – the hospital. Yet, as reported in the research from transitional care, this primary focus on episodic phases of care contributes to sub-optimal patient outcomes since nurses and other providers are not temporally focused on meeting health needs across discrete episodes (Naylor et al. 2009). While trauma care may not be ‘episodic’ in the way that some chronic diseases are (e.g. congestive heart failure with repeated exacerbations of failure), care of seriously injured trauma patients must be conceived across the artificial geographic boundaries of EDs, ICUs, medical surgical units, rehabilitation units, hospitals and communities. To overcome these limitations, we conceptualise the trauma model as occurring over time, place, and structures, but with each component integrally linked. It is within this foundation that we substantively alter the current QHOM to explicitly address the reality of care provided across previously discrete systems and strongly propose the need to consider care not only within one system, but across systems as critically important.

In Figure 1, we highlight three structured care settings – pre-definitive care, definitive care and post-discharge. We use the language of structured care settings

to emphasize that these settings may or may not be physically demarcated institutions such as an acute care hospital that provides definitive care. In the model, both the pre-definitive care and post-discharge structured care settings are surrounded by a dotted line since it is possible that these settings may not be a physical institution (e.g. rural hospital that stabilized the patient, rehabilitation hospital or skilled nursing facility) but is often a set of structured services provided in the person's home (e.g. visiting nurses, in-home rehabilitation therapies). Regardless of the physical structure, the QHOM components apply in any structured care setting where trauma care is provided.

We agree with many of the component definitions presented in the original QHOM model and also with the central proposition that nursing care influences patient outcomes only through the organizational structure and patient/family (Mitchell et al. 1998). We expand the original definitions and provide additional definitions for clarity and for applicability to trauma care in order to highlight the implications of phases of care in relation to long term outcomes (see Table 3).

Given the multiple structured care settings through which trauma patients pass, it is essential to consider the QHOM components within each setting (i.e. the hospital providing definitive care) but also across each setting (i.e. moving from pre-hospital, to acute care, to rehabilitative or supportive services). Of particular relevance is the outcomes focus within and across settings. Nursing practice and nursing science have moved beyond sole focus on process to linking process interventions to outcomes. This progress within our discipline is laudatory but

continues to be limited to a focus on outcomes of each isolated phase of care as opposed to long-term outcome focused. In this model, the emphasis is on the long-term outcomes and the variety of paths and contributors to these long-term outcomes. Importantly, the intermediate outcomes achieved within each structured care setting influence the long term outcomes through each of the subsequent care settings.

Outcomes. Long-term outcomes are central to the conceptualisation and delivery of quality nursing trauma care. Because of the diversity of injury mechanism, type and severity, these long-term outcomes occur across a time continuum that may span only weeks or extend for years (Ottosson et al. 2005). This presents a challenge because important outcomes span settings, time, and providers that are often not organisationally connected and that almost always extend beyond a single care setting. The Trauma Outcomes Model posits that the long-term outcomes are of greatest import and that care provided in the acute and post-discharge phases should focus on maximising long-term outcomes. Our focus on long-term outcomes is not meant to minimise the importance of the intermediate outcomes achieved during each phase of care but to refocus our attention on linking these intermediate outcomes to the final outcomes.

Interventions. Nursing interventions represent the direct and indirect processes of care that are delivered by nurses to influence patient outcomes. Early resuscitation nursing care processes tend to be algorithmic and assessment and interventions occur simultaneously to maximize survival. Classic examples include

the A,B,Cs (airway, breathing, circulation) of emergent trauma care. Nurses, as all members of the multidisciplinary trauma team focus on the delivery of evidence-based trauma care. A recent analysis indicates that a major barrier to implementing evidence-based guidelines in trauma is the segmentation of trauma care and the consequent breakdown at every boundary as patients move through the phases of care (March 2006). The Trauma Outcomes Model is designed to help us consider how to move past these organizational barriers to quality care.

Application of the Model to Trauma Care Systems

The expansion of the QHOM to the Trauma Outcomes Model recognizes the complex and phase-specific nature of trauma care. The Trauma Outcomes Model is intended to prompt nurse researchers to expand their science to incorporate the concept of a trajectory over time and place and to assist clinical nurses in designing care that considers long-term outcomes. Nurses provide trauma care throughout this trajectory and consequently work in structured care settings that span pre-hospital care (e.g. helicopter transport from the scene or a non-trauma setting to definitive care), acute hospital care (e.g. acute resuscitation, surgical critical care), and post-discharge care (e.g. rehabilitation hospital, visiting nurse). Regardless of where in the trajectory care is provided, all nurses need to consider designing care to optimise long-term outcomes, thus in this model, we believe it is important to explicate priority outcomes. These outcomes are grounded in a biopsychosocial framework and are further derived from the subsequent work on evaluating the

contribution of the QHOM to improving healthcare quality by Mitchell & Lang (2004).

For trauma, we identify 3 priority long-term outcomes: 1) survival is enhanced and morbidity is reduced; 2) humanity and individual dignity are maintained and enhanced; and 3) physical, functional, psychological recovery and quality of life are maximized (Table 4). Although perceptions of being well-cared for was posited initially in considering outcomes in the QHOM, we have broadened this to a more sophisticated and ethically-based outcome of maintaining humanity and individual dignity.

Early phase interventions (e.g. pre-hospital, emergency, critical care) have the potential to lead to very different long term outcomes (National Center for Injury Prevention & Control 2009). Therefore, as nurses conceive of intermediate outcomes specific to their care setting, the intermediate outcomes should be aligned with moving the patient toward one or more of the long-term outcomes. For example, consider the first long-term outcome ‘survival is enhanced and morbidity is reduced’. The pre-hospital nurse may set intermediate goals that concentrate on airway, oxygenation, and bleeding (see Table 5 for specific examples). In turn, the critical care nurse is likely to focus on different intermediate outcomes depending on the array of injuries of varying severity as well as co-morbidities; these may incorporate respiratory and haemodynamic stability, but expand to include issues of nutrition and wound care. As the injured person becomes physiologically stable, he/she is likely transferred to a surgical unit and another set of intermediate aims

are set that build on the critical care achievements and prepare the person for hospital discharge. Once discharged from the hospital he/she may continue to require rehabilitative or other community health services. In this phase the nurse also sets intermediate outcomes that are likely to focus on ensuring the patient, with the support of their family, is able to meet their own care needs and that normal activities are gradually re-established.

Intermediate outcomes contribute to the long-term outcomes of care. Within each long-term outcome a number of major nursing priorities are identified that outline the broad parameter of nursing care (Table 4) but which must be made more precise and individualised to the person's injury status and location on the trajectory of care. Staying with the long-term outcome of 'survival is enhanced and morbidity is reduced,' three major nursing priorities are identified including 1) establish physiologic stability from the injury and responses to the injury; 2) diagnose injuries and definitively treat in a timely manner; and 3) prevent complications that will worsen morbidity both acutely and over the long-term. Specific actions of the nurse will be dependent on phase of care, structural components and person characteristics, but all actions are focused on achieving the intermediate and long-term outcomes. Take for example a potential cervical spine injury. In the pre-hospital phase, the nurse places a stabilising collar on the patient, while in the critical care phase the nurse now focuses on final clearance of the cervical spine and aggressively working the system to remove the collar as early as is safe – to minimize the chance for skin breakdown. Both approaches are aimed at

the long term outcomes of enhancing survival (cervical spinal cord injury is associated with lower life expectancy; Richmond & Lemaire 2008) and reducing morbidity (all the associated complications of cervical spinal cord injury), but the actions vary within each phase of care.

Similarly, the second and third long term outcomes also require care to be individualised to each patient, their current position on the care trajectory and person and family characteristics. The second long term outcome of 'humanity and individual dignity is maintained and enhanced' involves nursing priorities that focus on the patient as a person within a family, who has a right to make decisions, express their sense of self and maintain dignity throughout the entire trauma care continuum (Table 4). It is likely that this long-term outcome is the one that gets lost or perhaps viewed as a 'soft' outcome. However, we suggest that nurses are central at each phase of care in maintaining personhood and that the injured person's memories of the event are directly affected by the manner in which they were treated.

The essence of the third long term outcome of 'physical, functional, psychological recovery and quality of life is maximised' requires recognition of all aspects of the injured person's recovery, including strategies to optimize physical and functional recovery, reestablish pre-injury activities, be psychologically healthy and satisfied with the quality of life that they attain (Table 4). Interventions at each phase have direct impact on this long-term outcome. Skin breakdown, loss of range of motion and foot drop can be easily understood to contribute to sub-optimal

functional recovery and interventions to prevent these are directly and independently under the purview of nursing practice. Nurses also hold responsibility for those complications that are linked to interventions (or lack of interventions) from the broader multidisciplinary team. For example, hypoxic or anoxic events can worsen cognitive function or hypotension that is proven to worsen functional and physical outcome after brain injury.

IMPLICATIONS FOR RESEARCH & PRACTICE

The Trauma Outcomes Model is an outgrowth of the well-known and widely used QHOM and is informed by the relevant literature, knowledge of current research and educational priorities in trauma nursing, and the expertise and research output of the two authors coming from two different systems of care in the U.S. and Australia. We build on the seminal work of the Quality Health Outcomes Model and articulate foundational assumptions and proposed linkages between concepts. The Trauma Outcomes Model needs further refinement and validation with expert trauma nurses and nurse scientists in order to assess its practical contribution to practice and research.

This Trauma Outcomes Model provides a framework to assist trauma nurses and researchers to consider the injured person in the context of the social, economic, cultural and physical environment from the time of injury through to recovery. The achievement of intermediate outcomes are the result of the characteristics of the injured person and their family, the health care structure, and the nursing interventions delivered in each phase of trauma care and influence and have

congruence with long term outcomes. This model is applicable to all trauma settings including civilian, military and veteran health environments and may extend across multiple geographical regions or countries.

The model is not intended to exclude consideration of other influencing factors or to narrow the scrutiny that nurses bring to their field of practice, instead it is intended to encourage them to view the injured person in the context of the environment from which they come and the long term goals that each person has as he/she recovers from injury. It is also not intended to suggest that there is a universal approach to the care of the injured person, or to suggest that nurses should be making generalisations in their care, rather it is intended to encourage trauma nurses to consider each person's individual characteristics, strengths and needs as they determine appropriate care.

CONCLUSION

We intend that the Trauma Outcomes Model proposed in this paper will provide guidance to nurses practicing and researching across the trauma continuum. The model explicitly stimulates nurses and researchers to consider the care that is delivered beyond one setting and to consider designing and testing interventions that include long-term outcomes in addition to setting or phase-specific outcomes. Finally, this model emphasizes the importance of working towards integration of episodes of care.

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Table 1: Summary of papers that informed development of the Trauma Outcomes Model

Author	Title	Method
Anzai et al 2006	Factors influencing discharge location following high lesion spinal cord injury rehabilitation in British Columbia, Canada	Retrospective chart review of 52 individuals
Barondess 2008	Health through the urban lens	Expert opinion
Branas et al 2004	Urban-rural shifts in intentional firearm death: Different causes, same results	Retrospective analysis of death data
Cameron et al 2006	Ten-year health service use outcomes in a population-based cohort of 21,000 injured adults: the Manitoba injury outcome study	Retrospective population based cohort study
Cobb & Pridgen 2008	Polytrauma care: a delicate balance for the military nurse case manager	Expert opinion
Colombo et al 2008	Critical care medicine at Walter Reed Army Medical Center in support of the global war on terrorism	Expert opinion
Cuckier 2002	Small arms and light weapons: A public health approach	Expert opinion
Danne 2003	Trauma management in Australia and the tyranny of distance	Expert opinion
Eastridge et al 2006	Trauma system development in a theater of war: Experiences from Operation Iraqi Freedom and Operation Enduring Freedom	Retrospective analysis of system issues
Fang et al 2008	Critical care at Landstuhl Regional Medical Center	Expert opinion
Fecura et al 2008	Nurses' role in the Joint Theatre Trauma System	Expert opinion

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Fraser & Curtis 2006	A day in the life of a trauma case manager	Expert opinion
Griffith et al 2001	The Trauma Program Manager role: a current examination	Retrospective review of administrative records
Gururaj 2004	Injuries in India: A national perspective	Retrospective review of existing datasets
Haider et al 2008	Race and insurance status as risk factors for trauma mortality	Retrospective database analysis
Halcomb & Davidson 2005	Using the illness trajectory framework to describe recovery from traumatic injury	Discussion paper
He et al 2005	65+ in the United States: 2005	Retrospective analysis of U.S. census data
Lim et al 2007	Factors influencing discharge location after hospitalization resulting from a traumatic fall among older persons	Population based case-only study
Long et al 2002	The role of the nurse within the multi-professional rehabilitation team	Ethnographic study and expert workshops
MacKenzie et al 2006	A national evaluation of the effect of trauma-center care on mortality	Retrospective data base analysis
Manwell et al 2005	Patient reaction to traumatic injury and inpatient AODA consult: Six-month follow-up	Prospective cohort study with follow-up at six months
Minkler et al 2006	Gradient of disability across the socioeconomic spectrum in the United States	Retrospective analysis of national survey data

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Mitchell et al 1998	Quality health outcomes model	Discussion paper
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Table 2: Theoretical Linkages and Underlying Assumptions

- All elements of the injury continuum from pre-injury risk through to long-term outcomes of trauma care take place within and are directly affected, both positively and negatively, by all aspects of the socio-economic-cultural environment.
- Pre-injury person and family factors come with the person to all phases of care and these factors directly affect the interventions, structure and intermediate outcomes of care. These factors include genetic pre-dispositions, substance use and the life journey of the person and family. These factors directly affect risk for injury and long-term outcomes and indirectly affect outcomes of each structured care setting.
- Injury results from the application of external forces to the body that exceed the tissues abilities to withstand those forces. Injuries are heterogeneous in terms of cause, type, and severity and these characteristics both directly affect long-term outcomes and indirectly affect long-term outcomes through structured care settings.
- Each of the three structured care settings (pre-definitive care, definitive acute care, and post-discharge care) incorporates the quality health outcomes model and its underlying premises. Intermediate outcomes from each setting both directly, and indirectly through each of the subsequent structured care settings, affect long-term outcomes.
- Intermediate outcomes of each phase of care should be synchronous with

enhancing the likelihood of long-term outcomes.

Table 3: Concept Definitions of the Original QHOM Model (Mitchell, Ferketich, & Jennings, 1998) and as Applied in the Trauma Care Model

Term	QHOM Definition	As applied to the Trauma Care Model
System Characteristics	“...an organized agency, such as a hospital or provider network, then the size, ownership, skill mix, client demographics and technology would be among structural elements that interact with treatment intervention processes to affect health outcomes.”	Same
Interventions	“...clinical processes are direct and indirect interventions and related activities by which they are delivered.”	Same
Client (original QHOM term) Person and family (Trauma Care Model Term)	“...outcomes will be affected by the characteristics of the clients to whom the interventions are directed.”	Person and family bring a unique life trajectory, co-morbid conditions, resources, values and beliefs to the trauma system.

<p>Intermediate Outcomes (We use an original QHOM definition, but clarify the term as intermediate for outcomes at the end of a phase of care.)</p>	<p>“Outcome measures should be results of care structures and processes that integrate the function, social, psychological, physical, and physiological aspects of people’s experiences with health and illness.”</p>	<p>Same</p>
<p>Long-term Outcomes</p>	<p>“Outcome measures should be operationalized in five categories: achievement of appropriate self-care, demonstration of health-promoting behaviors, health-related quality of life, perception of being well-cared for, and symptom management.”</p>	<p>The focal points of long-term outcomes include three major categories: 1) survival is enhanced and morbidity is reduced; 2) humanity and individual dignity is maintained and enhanced; 3) Physical, functional, psychological recovery and quality of life is maximized.</p>

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Table 4: Long term outcomes and associated nursing priorities

Long Term Outcomes	Nursing Priorities
Survival is enhanced and morbidity is reduced	Establish physiologic stability from the injury and responses to the injury
	Diagnose injuries and definitively treated in a timely manner
	Prevent complications that will worsen morbidity both acutely and over the long-term
Humanity and individual dignity is maintained and enhanced	Optimally manage pain and suffering
	Treat as a sentient human being who is able to make decisions about him/herself and care at the highest level possible
	Provide care within the pre-existing social and family structure that is supported and enhanced during vulnerable times
	Treated with dignity and to have a voice throughout all aspects of care
Physical, functional, psychological recovery, and quality	Maximize physical mobility and function as well as independent activities and roles

Trauma Model

of life is maximized	Prevent bad memories, recognise and address psychological consequences that emerge after or worsen because of the injury event
	Support patient and family in anticipating challenges and issues that will arise across phases of post-injury recovery

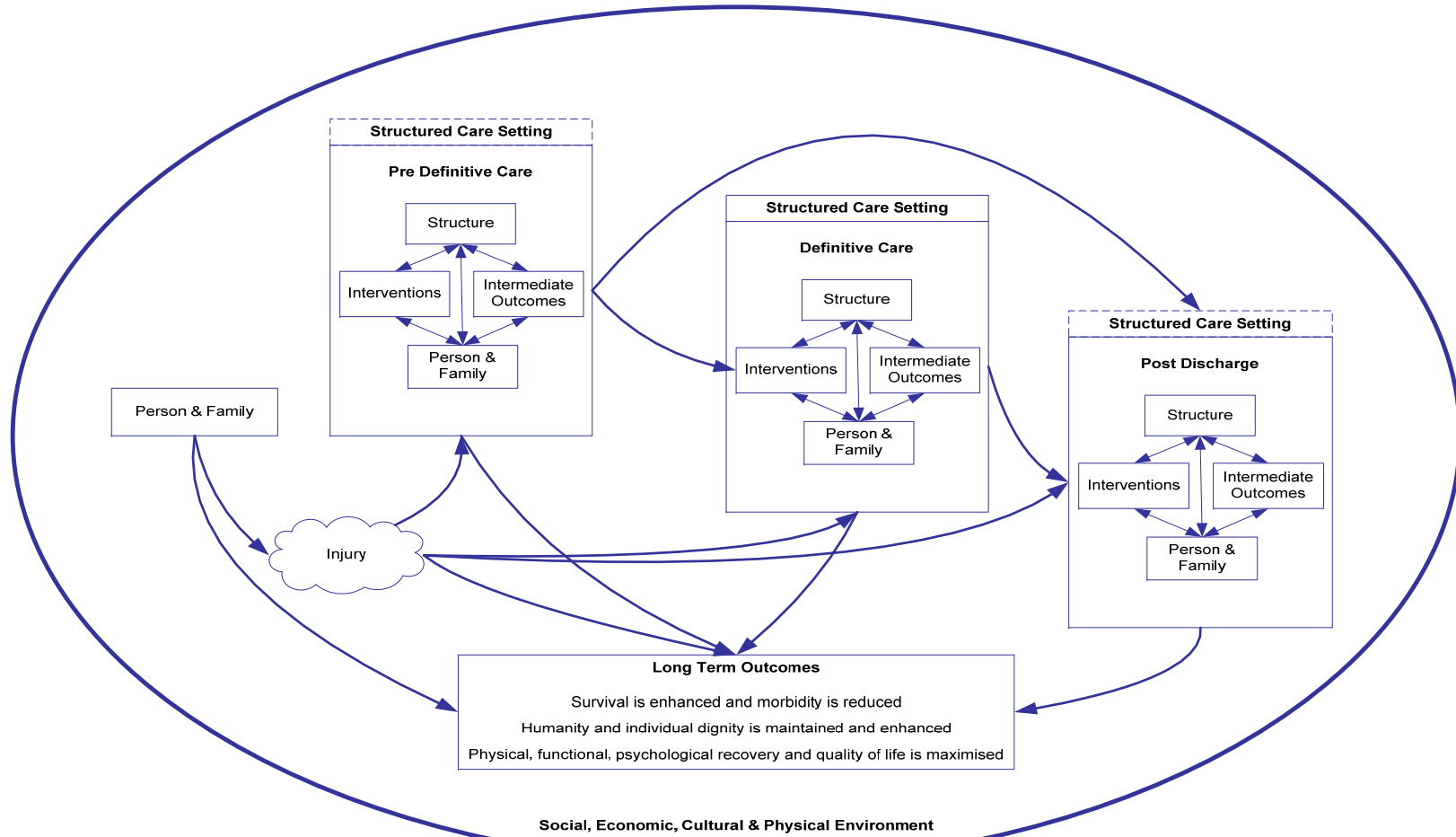
Table 5: Example of interim goals related to long-term outcome of ‘survival is enhanced and morbidity is reduced’

Pre-definitive care	Definitive care	Post Discharge
<ul style="list-style-type: none"> • airway is secured • oxygen saturation is maintained >90% • external bleeding is stopped • systolic BP is maintained >90mmHg • cervical spine is maintained in neutral/protected position 	<p><i>Critical Care goal examples:</i></p> <ul style="list-style-type: none"> • lungs remain clear of infection • hemodynamic stability is maintained • intracranial pressure is maintained <15mmHg • skin is intact • calculated caloric need is met by day 7 <p><i>Surgical Ward/Unit goal examples:</i></p> <ul style="list-style-type: none"> • joints maintain full range of motion • orientation to person and place is achieved 	<ul style="list-style-type: none"> • family able to administer antibiotics as scheduled • wound closes • walks independently around home • lung sounds remain clear

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	<ul style="list-style-type: none">• able to feed self with assistance in setting up meals• skin is intact• calculated caloric needs are fully and consistently met	
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Trauma Model



Trauma Outcomes Model

(adapted from Quality Health Outcomes Model, Mitchell et al. 1998)