

Richmond, T. S. & Aitken, L. M. (2011). A model to advance nursing science in trauma practice and injury outcomes research. *Journal of Advanced Nursing*, 67(12), pp. 2741-2753. doi: 10.1111/j.1365-2648.2011.05749.x



**CITY UNIVERSITY
LONDON**

[City Research Online](#)

Original citation: Richmond, T. S. & Aitken, L. M. (2011). A model to advance nursing science in trauma practice and injury outcomes research. *Journal of Advanced Nursing*, 67(12), pp. 2741-2753. doi: 10.1111/j.1365-2648.2011.05749.x

Permanent City Research Online URL: <http://openaccess.city.ac.uk/14099/>

Copyright & reuse

City University London has developed City Research Online so that its users may access the research outputs of City University London's staff. Copyright © and Moral Rights for this paper are retained by the individual author(s) and/ or other copyright holders. All material in City Research Online is checked for eligibility for copyright before being made available in the live archive. URLs from City Research Online may be freely distributed and linked to from other web pages.

Versions of research

The version in City Research Online may differ from the final published version. Users are advised to check the Permanent City Research Online URL above for the status of the paper.

Enquiries

If you have any enquiries about any aspect of City Research Online, or if you wish to make contact with the author(s) of this paper, please email the team at publications@city.ac.uk.

A model to advance nursing science in trauma practice and injury outcomes
research

Therese S Richmond PhD, CRNP, FAAN

Andrea B. Laporte Endowed Term Associate Professor

Division of Biobehavioral & Health Sciences

School of Nursing

University of Pennsylvania

Philadelphia, PA USA

Leanne M Aitken RN, PhD

Professor of Critical Care Nursing

Research Centre for Clinical and Community Practice Innovation, Griffith

University and Princess Alexandra Hospital

Brisbane, QLD Australia

Contact Details:

Dr T Richmond

Email: terryr@nursing.upenn.edu

Phone: +1 215-573-7646

Fax: +1 215-573-7507

Conflicts of Interest

No conflict of interest has been declared by the author(s).

Funding

This project received no specific grant from any funding agency, however Dr Aitken was undertaking a Australian-American Fulbright Commission funded Fulbright Senior Scholarship within the School of Nursing, University of Pennsylvania at the time of developing the model and manuscript.

Acknowledgements

We acknowledge the contribution of Bonnie Jennings and Pamela Mitchell in their critical review and constructive feedback of this manuscript.

Author contributions

TSR & LA were responsible for the study conception and design. TSR & LA performed the data collection. TSR & LA were responsible for the drafting of the manuscript. TSR & LA made critical revisions to the paper for important intellectual content. TSR & LA obtained funding. TSR & LA provided administrative, technical or material support.

ABSTRACT

Aims: This paper presents a model to advance nursing science and practice in trauma care.

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.

Data Sources: Literature was obtained by searching CINAHL, PubMed and OvidMedline databases for 1990 – 2010. Search terms included trauma, nursing, scope of practice and role, with results restricted to those published in English. Manual searches of relevant journals and websites were undertaken.

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

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

Trauma is a significant health problem across the lifespan, ranking in the top ten causes of death and projected to rank as the 4th leading cause of disability adjusted life years by 2030 globally (Mathers et al., 2009; Mathers & Loncar, 2006). Trauma 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 beyond which can be withstood. The severity of traumatic injury ranges from minor to serious and those that are considered incompatible with life. Anatomical scoring systems such as the Injury Severity Score (Baker et al 1974) and physiological scoring systems such as the triage 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 traumatic injury and the unique needs of injured patients, trauma systems have been developed over the past two decades. These trauma systems encompass broad geographical areas and/or smaller areas with high population density and trauma-dedicated services have been established within appropriate 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 not sufficient. Instead, return to previous level of function and reintegration into pre-injury lifestyle, such as return to normal family, community, education, work, leisure, or retirement activities are now recognised as important outcomes of trauma care. These outcomes are not immediate; there is

growing evidence that recovery from trauma can take longer than 2 years. Up to half of all patients report compromise in functional, quality of life, 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 more than 3 years after injury (Livingston et al. 2009). Health related quality of life (QOL) is reported to be lower for trauma patients 18 months after injury compared with the general population norm, with specific problems that include delusional memories (Ringdal et al 2009) and injury related pain (Rivara et al. 2008). Similarly, 10 - 20% of injured patients reported Post Traumatic Stress Disorder and up to 18% report depression 12 months after injury (O'Donnell et al. 2004, Richmond et al. 2009, Zatzick et al. 2008).

Ongoing economic 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 after 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 of recovery 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 by trauma patients provide us with an understanding of what aspects of function continue to be compromised, however to improve long term recovery it is essential that we consider what factors affect this recovery. Whereas scoring systems as the Injury Severity Score and the triage Revised Trauma Score predict mortality, they do not effectively predict post-injury functional recovery in the general trauma population (Richmond et al. 2009). Yet, there is evidence that patients with compromised recovery can be identified at the time of acute hospitalization or soon after by other risk factors. Demographic variables such as pre-injury education and employment level (Connelly et al. 2006), treatment factors such 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)

without carefully considering the important long-term outcomes of all 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 multi-disciplinary 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 this model of care, nurses in all of these specialties provide trauma nursing 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 professional nurses caring for injured patients and consequently do not provide clarity around the trauma nurse's role. Instead, 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 aspects of these 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 unique nursing interventions and considerations required to care for the injured patient. Of particular relevance, current acute nursing care frameworks do not recognize the relevance or 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 continuum of care 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 traumatic injury. The strengths of this description include the long term approach to recovery, acknowledgement of the biopsychosocial impact of injury and the recognition that pre-injury factors affect recovery. This framework also acknowledges the inter-relationship of the actions of both the injured person and the health care team (Halcomb & Davidson 2005). The significant limitation of this description 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, these interventions and recovery.

In this paper, we propose a model to advance nursing science and practice in trauma care. The authors bring decades of expertise in trauma care from two different 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 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 were conducted using CINAHL, PubMed, and OvidMedline databases identified 569, 1504, and 613 potential articles, respectively. Abstracts were reviewed to identify relevant papers. In addition, manual searches were undertaken of the *Journal of Trauma Nursing* since 2005. Targeted searches were 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.

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 care 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 therefore the interventions that are provided, will be driven by the needs of the injured person and his/her family. Below we define and

discuss the concepts central to the model and related theoretical linkages between the core concepts.

Concepts Central to the Model

The trauma model we present here builds on the Quality Health Outcomes Model, a well-known and widely used model built on structure, process, and outcomes, but in a non-linear manner. Core concepts from the QHOM are client, system, process, and outcome. We add the additional concept of 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 systems of care that span pre-injury emergency care through return to the community. We label these structured care systems. We acknowledge that the nursing interventions take place within each structured care systems 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 1).

Environment. Trauma is a societal health problem and 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 distinctly 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 also found across

countries because of different levels of development, cultural norms, or civil stability. Examples are many: a spike in road 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 the quality and rapidity of trauma care delivery based on trauma systems 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 are directed by formal triage protocols to transport the injured person to the appropriate level of care in the shortest time possible in order to reduce mortality and morbidity; these principles apply to both the civilian and military trauma environment (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 that has large distances and areas with low population density resulting in longer transport times reduce the likelihood of rapid, definitive care, ultimately reducing the likelihood 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).

All aspects of the environment, including non-injury factors, influence post-discharge location and long-term outcomes. In the United States, economics such as insurance coverage in conjunction with other social factors such as race, gender, age, and injury type and severity 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) and stroke patients in Australia (Nguyen et al. 2007) although limited examination of the issue outside the United States 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 available resources. Classically, trauma has been considered a young person's disease and in developing countries this continues to be the case. 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 intensive care units (ICU) 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 persons and their families and are privileged to care for them during this vulnerable post-injury time.

We can anticipate that 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 from lower SES classes 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 hospitals and centres, and community health systems. The QHOM has primarily been conceptualised as occurring within a discrete organization – the hospital - reflecting the manner by which health care is predominately delivered through much of the world. Yet, as

reported in the research from transitional care, focusing primarily or solely 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 or phases of care. 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 as outpatient or 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 care is provided to trauma patients.

The QHOM component definitions are those provided in the original model and we agree with many of the definitions of the original model and also with the central proposition that nursing care does not directly influence patient outcomes, but does so only through the organizational structure and patient characteristics (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 2).

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. Nurses, nursing practice, and nursing science have moved aggressively beyond sole focus on process or intervention to linking 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 both directly and indirectly 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 outcomes of import span settings, time, and sets of providers that are often not organisationally connected and that almost always extend beyond whatever outcome assessments are in place. The trauma care model posits that the outcomes of greatest import are these long-term outcomes and that care provided in the acute and post-discharge phases of care should be focused on maximising these final 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. As patients progress through phases of care, the individualized application of evidence-based care is the norm.

Application of the Model to Trauma Care Systems

The explicit expansion of the QHOM to the Trauma Care Model is to recognize the complex and phase-specific nature of trauma care. We propose the expansion to the Trauma Care Model is important to inform 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 the trauma population 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 3). 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.

Treatments provided in early phases of trauma (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). As nurses conceive of intermediate outcomes specific to their care setting, the intermediate outcomes are likely to be more precise and 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, haemodynamic stability and bleeding (see Table 4 for specific examples). In turn, the critical care nurse is likely to focus on different intermediate outcomes depending on the vast array of injuries of varying severity as well as co-morbidities; these may incorporate respiratory and haemodynamic stability, but may also 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 the person is discharged from the definitive care hospital he/she may continue to require rehabilitative services and 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 his/her family, is able to meet their own care needs and that normal activities are gradually re-established.

All 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 3) 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 definitely treat in a timely manner; and 3) prevent complications that will worsen morbidity both acutely and over the long-term. Again, 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 the potential for 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 and social structure, who has a right to make decisions, express their sense of self and maintain their dignity throughout the entire trauma care continuum (Table 3). 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 in maintaining personhood and that the injured person’s memories and processing of the event is 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 maximise physical and functional recovery, reestablish their pre-injury activities, be psychologically healthy and satisfied with the quality of life that they attain (Table 3).

Interventions at every phase have direct impact on this long-term outcome. Such complications as skin breakdown, loss of range of motion, 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 is known 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 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 to provide guidance to nurses practicing and researching across the trauma continuum. The model explicitly asks 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.

References

American Association of Critical Care Nurses. (2008) AACN Scope and Standards for Acute and Critical Care Nursing Practice. Aliso Viejo, CA. AACN#130300.

Anzai K., Young J., McCallum J., Miller B. & Jongbloed L. (2006) Factors influencing discharge location following high lesion spinal cord injury rehabilitation in British Columbia, Canada. *Spinal Cord* 44(1), 11-18.

Baker S.P., O'Neill B., Haddon W., & Long W. (1974). The Injury Severity Score: A method for describing patients with multiple injuries and evaluating emergency care. *Journal of Trauma* 14, 187-196.

Barondess J.A. (2008) Health through the urban lens. *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 85, 787-801.

Branas C.C., Nance M.L., Elliott M.R., Richmond T.S. & Schwab C.W. (2004) Urban-rural shifts in intentional firearm death: Different causes, same results. *American Journal of Public Health* 94, 1750-1755.

Cameron C.M., Purdie D.M., Kliewer E.V. & McClure, R.J. (2006) Ten-year health service use outcomes in a population-based cohort of 21,000 injured adults: the Manitoba injury outcome study. *Bulletin of the World Health Organization* 84(10), 802-810.

Champion H.R., Sacco W.J., Copes W.S., Gann D.S., Gennarelli T.A., & Flanagan M.E. (1989). A revision of the trauma score. *Journal of Trauma* 29, 623-629.

Cobb A.M. & Pridgen N. (2008) Polytrauma care: a delicate balance for the military nurse case manager. *Journal of Trauma Nursing* 15(4), 192-196.

Colombo C.J., Mount C.A., & Popa C.A. (2008). Critical care medicine at Walter Reed Army Medical Center in support of the global war on terrorism. *Critical Care Medicine* 36 (7 Supplement), S388-S394.

Connelly J., Chell S., Tennant A., Rigby A.S. & Airey, C.M. (2006) Modelling 5-year functional outcome in a major traumatic injury survivor cohort. *Disability and Rehabilitation* 28(10), 629-636.

Corbin J.M. & Strauss A. (1991) A nursing model for chronic illness management based upon the Trajectory Framework. *Scholarly Inquiry for Nursing Practice* 5(3), 155-74.

Cukier W. (2002) Small arms and light weapons: A public health approach. *The Brown Journal of World Affairs IX*, 261 – 280.

Danne P. (2003) Trauma management in Australia and the tyranny of distance. *World Journal of Surgery* 27(4), 385-389.

Fang R, Pruitt V.M., Dorlac G.R., Silvey S.V., Osborn E.C., Allan P.F., Flaherty S.F., Perello M.M., Wanek S.M., & Dorlac W.C. (2008). Critical care at Landstuhl Regional Medical Center. *Critical Care Medicine*, 36(7 Supplement), S383-387.

Fecura S.E., Martin C.M., Martin K.D., Bolenbaucher R.M. & Cotner-Pouncy T. (2008) Nurses' role in the Joint Theatre Trauma System. *Journal of Trauma Nursing* 15(4), 170-173.

Gabbe B.J., Sutherland A.M., Williamson O.D. & Cameron P.A. (2007) Use of health care services 6 months following major trauma. *Australian Health Review* 31(4), 628-632.

- Griffith P.M., Alo K. & Cohen, M. (2001) The Trauma Program Manager role: a current examination. *Journal of Trauma Nursing* 8(3), 75-84.
- Gururaj G. (2004) Injuries in India: A national perspective. *Report of the National Institute of Mental Health and Neurosciences*, Bangalore, India, 325-347.
- Haider A.H., Chang D.C., Efron D.T., Haut E.R., Crandall M. & Cornwell E.E.3rd. (2008) Race and insurance status as risk factors for trauma mortality. *Archives of Surgery* 143(10), 945-949.
- Halcomb E. & Davidson P. (2005) Using the illness trajectory framework to describe recovery from traumatic injury. *Contemporary Nurse* 19(1-2), 232-241.
- He W., Sengupta M., Velkoff V.A. & DeBarros K.A. (2005) *65+ in the United States: 2005. Current Population Reports*. Washington DC: U.S. Department of Health & Human Services and U.S. Department of Commerce.
- Holtslag H.R., van Beeck E.F., Lindeman E., Leenen L.P.H. (2007) Determinants of long-term functional consequences after major trauma. *Journal of Trauma: Injury, Infection, & Critical Care* 62(4), 919-927.
- Kim J. & Miech R. (2008) The Black-White difference in age trajectories of functional health over the life course. *Social Science & Medicine* 68, 717-725.
- Lim H.J., Hoffmann R. & Brasel K. (2007) Factors influencing discharge location after hospitalization resulting from a traumatic fall among older persons. *Journal of Trauma: Injury, Infection, & Critical Care* 63, 902-907.

- Livingston D.H., Tripp T. Biggs C. & Lavery R.F. (2009) A fate worse than death? Long-term outcome of trauma patients admitted to the surgical intensive care unit. *Journal of Trauma: Injury, Infection, & Critical Care* 67(2), 341-348.
- Long A.F., Kneafsey R., Ryan J. & Berry, J. (2002) The role of the nurse within the multi-professional rehabilitation team. *Journal of Advanced Nursing* 37(1), 70-78.
- MacKenzie E.J., Rivara F.P., Jurkovich G.J., Nathens A.B., Frey K.P., Egleston B.L., Salkever D.W. & Scharfstein, D.O. (2006) A national evaluation of the effect of trauma-center care on mortality. *New England Journal of Medicine* 354, 366-378.
- Manwell L.B., Mindock S. & Mundt, M. (2005) Patient reaction to traumatic injury and inpatient AODA consult: Six-month follow-up. *Journal of Substance Abuse Treatment* 28, 41-47.
- Mathers C.D., Boerma, T., & Fat D.M. (2009). Global and regional causes of death. *British Medical Journal* 92, 7-32.
- Mathers C.D. & Loncar D. (2006). Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine* 3, e442.
- Minkler M., Fuller-Thomson E. & Guralnik, J.M. (2006) Gradient of disability across the socioeconomic spectrum in the United States. *New England Journal of Medicine* 355, 695-703.
- Mitchell M., Chaboyer W., Burmeister E. & Foster M. (2009) Positive effects of a nursing intervention on family-centered care in adult critical care. *American Journal of Critical Care* 18(6), 543-552.

Mitchell P.H., Ferketich S. & Jennings B.M. (1998) Quality health outcomes model. *Image: Journal of Nursing Scholarship* 30, 43-46.

Mitchell P.H. & Lang N.L. (2004). Framing the problem of measuring and improving health care quality: Has the Quality Health Outcomes Model been useful? *Medical Care* 42, II-4-II-11.

Nathens A.B., Jurkovich G.J., Cummings P., Rivara F.P. & Maier R.V. (2000) The effect of organized systems of trauma care on motor vehicle crash mortality. *Journal of the American Medical Association* 283, 1990-1994.

National Center for Injury Prevention & Control. (2009). CDC Injury Research Agenda, 2009-2018. Atlanta, GA. U.S. Department of Health & Human Services, Centers for Disease Control and Prevention.

Nguyen T.A., Page A., Aggarwal A. & Henke P. (2007) Social determinants of discharge destination for patients after stroke with low admission FIM instrument scores. *Archives of Physical Medicine and Rehabilitation* 88(6), 740-744.

O'Donnell M. L., Creamer M. & Pattison P. (2004) Posttraumatic stress disorder and depression following trauma: understanding comorbidity. *American Journal of Psychiatry* 161(8), 1390-1396.

O'Donnell M. L., Creamer M., Elliott P. & Atkin C. (2005) Health costs following motor vehicle accidents: The role of posttraumatic stress disorder. *Journal of Traumatic Stress* 18(5), 557-561.

O'Donnell M.L., Creamer M., Holmes A.C., Ellen S., McFarlane A.C., Judson R. Silove D. & Bryant R.A. (In Press) Posttraumatic Stress Disorder After Injury: Does

Admission to Intensive Care Unit Increase Risk? *Journal of Trauma: Injury, Infection, & Critical Care* DOI: 10.1097/TA.0b013e3181bc0923.

Olujić M.B. (1998) Embodiment of terror: Gendered violence in peacetime and wartime Croatia and Bosnia-Herzegovina. *Medical Anthropology Quarterly* 12(1), 31-50.

O'Mullane A., Mikocka-Walus A.A., Gabbe B.J. & Cameron P.A. (2009) Incidence and outcomes of major trauma assaults: A population-based study in Victoria. *Medical Journal of Australia* 190, 129-132.

Ottosson C., Nyren O., Johansson S-E. & Ponzer S. (2005) Outcome after minor traffic accidents: A follow-up study of orthopedic patients in an inner-city area emergency room. *Journal of Trauma: Injury, Infection, & Critical Care* 58, 533-560.

Peleg K., Aharonson-Daniel L., Stein M., Kluger Y., Michaelson M., Rivkind A., Boyko V. & the Israel Trauma Group (2004) Increased survival among severe trauma patients: the impact of a national trauma system. *Archives of Surgery* 139(11), 1231-1236.

Price S.J., Suttner N. & Aspoas A.R. (2003) Have ATLS national transfer guidelines improved the quality of resuscitation and transfer of head-injured patients? A prospective survey from a regional neurosurgical unit. *Injury* 34, 834-838.

Richmond T.S. (1997) An explanatory model of variables influencing post-injury disability. *Nursing Research* 46, 262-269.

- Richmond T.S., Amsterdam J.D., Guo W., Ackerson T., Gracias V., Robinson K.M. & Hollander J.E. (2009) The effect of post-injury depression on return to pre-injury function: a prospective cohort study. *Psychological Medicine* 39(10), 1709-1720.
- Richmond T.S., Kauder D., Hinkle J. & Shults J. (2003) Early predictors of long-term disability after injury. *American Journal of Critical Care*, 12(3), 197-205.
- Richmond T.S. & Lemaire J. (2008) Years of life lost because of gunshot injury to the spinal cord and brain. *American Journal of Physical Medicine & Rehabilitation* 7, 609-618.
- Ringdal M., Plos K., Lundberg D., Johansson L. & Bergbom I. (2009) Outcome after injury: memories, health-related quality of life, anxiety, and symptoms of depression after intensive care. *Journal of Trauma: Injury, Infection, & Critical Care* 66(4), 1226-1233.
- Rivara F.P., Mackenzie E.J., Jurkovich G.J., Nathens A.B., Wang J. & Scharfstein D.O. (2008) Prevalence of pain in patients 1 year after major trauma. *Archives of Surgery* 143(3), 282-287.
- Samuelson K., Lundberg D. & Fridlund B. (2006) Memory in relation to depth of sedation in adult mechanically ventilated intensive care patients. *Intensive Care Medicine* 32(5), 660-667.
- Selassie A.W., McCarthy M.L. & Pickelsimer E.E. (2003) The influence of insurance, race, and gender on emergency department disposition. *Academic Emergency Medicine* 10(11), 1260-1270.

- Shafi S., de la Plata C.M., Diaz-Arrastia R., Bransky A., Frankel H., Elliott A.C., Parks J. & Gentilello, L.M. (2007) Ethnic disparities exist in trauma care. *Journal of Trauma: Injury, Infection, & Critical Care* 63(5), 1138-1142.
- Shults R.A., Jones B.H., Kresnow M., Langlois J.A. & Guerrero J.L. (2004) Disability among adults injured in motor vehicle crashes in the United States. *Journal of Safety Research* 35, 447-452.
- Soberg H.L., Finset A., Bautz-Holter E., Sandvik L. & Roise O. (2007) Return to work after severe multiple injuries: a multidimensional approach on status 1 and 2 years postinjury. *Journal of Trauma: Injury, Infection, & Critical Care* 62(2), 471-481.
- Zatzick D., Jurkovich G.J., Rivara F.P., Wang J., Fan M.Y., Joesch J. & Mackenzie E. (2008) A national US study of posttraumatic stress disorder, depression, and work and functional outcomes after hospitalization for traumatic injury. *Annals of Surgery* 248(3), 429-437.

Table 1: 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 2: 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>

Table 3: 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

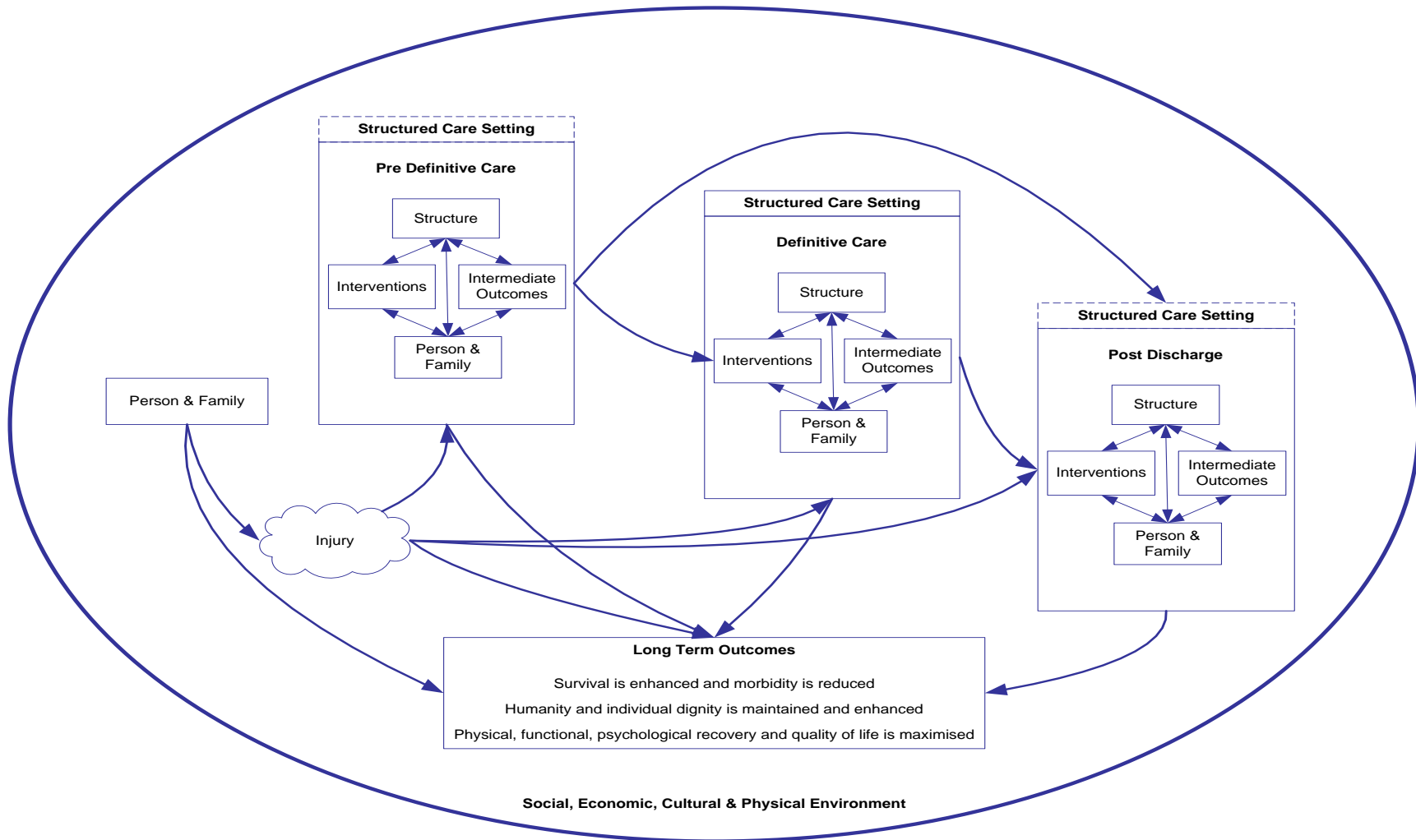
Table 4: Example of interim goals related to long-term outcome of ‘survival is enhanced and morbidity is reduced’

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

Trauma Model

	<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	
--	--	--

Trauma Model



Trauma Outcomes Model

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