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POST-HOSPITAL CARE FOR PEOPLE RECOVERING FROM ACUTE INJURIES IN LOW AND MIDDLE INCOME COUNTRIES: 5 DOMAINS OF HEALTH MANAGEMENT

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ABSTRACT

Injury is a leading cause of death and disability globally. After an acute hospitalization for an injury, a care transition model has been shown to reduce mortality and morbidity but these are uncommon in a low and middle income setting. When planning a post hospitalization care plan, many health management factors should be taken into account as they can impact outcome. This manuscript delineates a 5 Domains of Healthcare Management or '5 Domains' which should be addressed in this care transition model. The literature behind each of these domains and their impact on post hospitalization outcomes along with a case study of a care transition plan for a low income country is described.

Keywords: Transition of Care, Global Health, Injury, Health Outcomes, Low and Middle Income Countries

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INTRODUCTION

Transitioning of care from a hospital system to home successfully requires a cohesive health system and strong linkages between various care settings; without this system and care linkages, patient follow-up can be difficult and patients can be at a higher risk for adverse outcomes. (Rochester-Eyeguokan, Pincus, Patel, & Reitz, 2016) In high income countries (HIC), it is estimated that 20% of recently discharged patients are readmitted within 30 days (Verhaegh et al., 2014). An organized comprehensive care transitions strategy improves patient recovery by facilitating successful disease self-management, optimal quality of life, and continued monitoring from community-based providers and family.(Ostermann, 2014 #229} Care transition interventions in developed countries have demonstrated dramatic reductions in mortality, morbidity, and disability for a wide range of patient populations (Prior, McManus, White, & Davidson, 2014; Wee et al., 2014). However, these interventions have not yet been translated to low and middle income countries (LMIC) where countries tend to have fragmented health systems, large burdens of disease, and no post-acute community care.

Globally but most specifically in low and middle income settings, injuries are a growing health crisis; injuries cause over 6 million deaths annually and 650 million people worldwide living with an injury-related disability. (Organization, 2010) Residual disability, especially after acute injuries, can have rippling effects extending for years into the future and far beyond the individual.(Miranda, Kinra, Casas, Davey Smith, & Ebrahim, 2008) Managing the health and social needs of an adult injury patient requires a multidisciplinary team to address patient needs.(Momsen, Rasmussen, Nielsen, Iversen, & Lund, 2012) An organized comprehensive care transitions strategy improves patient recovery by facilitating successful disease self-management, optimal quality of life, and continued monitoring from community-based providers and family.(Ostermann et al., 2015) Care transition interventions in developed countries have demonstrated dramatic reductions in mortality, morbidity, and disability for a wide range of patient populations.(Prior et al., 2014; Wee et al., 2014) These care models and interventions have not been translated to low income countries (LIC), where resources and research are disproportionately invested in the early acute period of injury with little

focus on health care needs in the weeks and months following acute hospitalization.

Compiling our 25 years of global health experience, in over 15 different countries, our objective is to suggest a theoretical model for care transition model with a framework for implementation and research. Our framework for implementation describes the evidence supporting each component of the theoretical model and assessment tools paired with our domains to show the simplicity and applicability to low and middle income countries. Finally, we will present a case study of this care transition model in Moshi, Tanzania to show how this can be implemented and help to improve outcomes and inform future research.

Theoretical Model: Five Domains of Health Management

Upon discharge from an acute injury hospitalization, adult injury patients have a complex array of complications across the 'five domains' of health management: physical function (Davydow, Zatzick, et al., 2009), mental health (Davydow, Gifford, Desai, Bienvenu, & Needham, 2009; Ursano et al., 1999), substance abuse (Douglas F Zatzick, Jurkovich, Gentilello, Wisner, & Rivara, 2002), pain and comorbidities (including HIV) (Anke et al., 1997; Chiu et

al., 2014; Katon, 2003; Morrison et al., 2003; Yu et al., 2016) (Malchow & Black, 2008)(See Figure 1). Each of these domains will be assessed at individual, institutional, community and culture levels in conjunction with the model proposed.
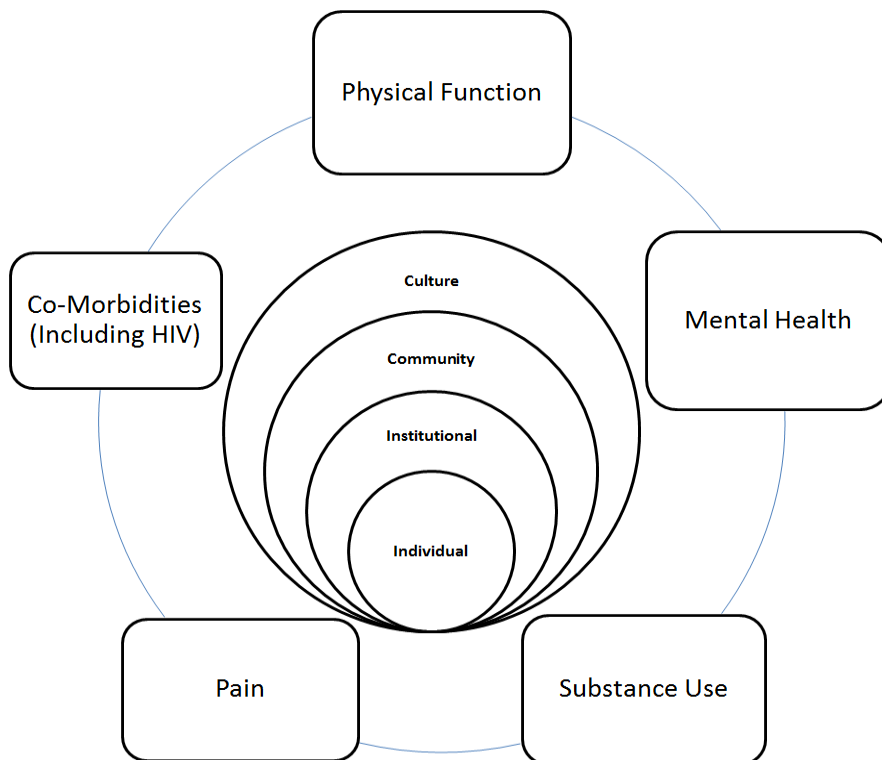
PHYSICAL FUNCTION

Loss or change in physical functionality is one of the more noticeable consequences of a trauma. Amputations, loss of mobility, and permanent impairments can make it difficult for individuals to return to their normal daily life or work and re-integrate into their community.(Esselman, Thombs, Magyar-Russell, & Fauerbach, 2006) A Norwegian study found that 3 years after a severe trauma, 80% of patients had residual impairments, 76% were unable to perform at least one non-work activity, with a median of loss of ability to perform six activities and an emphasis on physically-demanding activities.(Anke et al., 1997) Additionally, being able to return to a level of physical functioning that allows one to return to work carries over into other areas of well-being. In a Swedish study, burn patients 3 years post injury reported that patients who had returned to work scored better on the SF-36 Physical Domain scale for General Health, Bodily Pain, and Physical Functioning, but they also had better scores

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in the Mental Domain for Social Functioning and mental health.(Dyster-Aas, Kildal, & Willebrand, 2007) In multiple traumas, even a year after the majority of patients report difficulties in physical mobility, with over one-third also citing a lack of energy, difficulty sleeping, and feeling socially isolated.(Dimopoulou et al., 2004) Loss of physical functioning and mobility following injury directly affects an individual's return to work and other daily activities; additionally, it also has a strong impact on their mental health, long-term pain levels, and social functioning.

Figure 1: Five Domains of Healthcare Management

MENTAL HEALTH

A myriad of reasons including changes in physical and social functioning, and chronic pain can lead to mental health concerns which are very common following an injury. One study of neurotrauma patients found that one year after the trauma occurred, factors such as work status, general health, and satisfaction with recovery progress were all dependent on the patient's mental health status, based on SF-36 scores.(Michaels et al., 2000) In the same study, 42% of patients reported symptoms

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of depression one-year after, and 38% presented symptoms of posttraumatic stress disorder (PTSD).(Michaels et al., 2000) Similarly, another US-based study on adult trauma center injury patients found that one-year following their hospitalization, 30% of patients reported posttraumatic disorder symptoms, based on the Posttraumatic Stress Disorder Checklist (PCL-C).(Douglas F Zatzick et al., 2002) Feelings of loneliness and isolation are also prevalent post-trauma, with one study reporting 25% of patients stating that they felt more lonely following their injury.(Anke et al., 1997) With studies reporting that between one-fourth and half of patients report decreases in mental health following traumatic injuries, it is important to consider not just physical impairments but also mental impairments when addressing long-term injury rehabilitation.

SUBSTANCE USE

In a one-year follow up of adult trauma patients in the United States, 25% of individuals had an AUDIT score greater than 8, indicating alcohol misuse; 8% of patients displayed alcohol misuse coupled with PTSD.(Douglas F Zatzick et al., 2002) Substance use also is associated with mental health and other comorbidities; a large study in Washington state found that 99% of

injury patients reporting drug abuse also had at least one comorbid mental, alcohol, or chronic medical disorder.(D. F. Zatzick et al., 2017) Increased substance use can manifest itself in several different forms post-injury; one study found that one year after injury, 47.1% of patients reported increased drug use. The most common increased substance was alcohol (33.3%), but usage of illicit drugs (27.7%), pharmaceuticals over the prescribed amount (20.2%), and multiple substances (17.7%) was also noted; it was also found that substance abusing patients did not have higher Injury Severity Scores (ISS) when compared to non-substance using patients but did have lower mental health and reported higher levels of pain one year following the injury.(Michaels et al., 2000) Based on current literature, injury patients appear to be at a higher risk of abusing substances following injury; this is especially important to note since a high percentage of injury patients already report some form of substance misuse or mental health issue.

PAIN

Apart from the initial pain that occurs during an injury or trauma, long-term pain as a direct result of injury is a major concern. Injuries like severe burns can

permanently or partially damaged nerve endings, leading to lifelong, constant "background" pain that can have a detrimental effect on daily life for a patient unless managed therapeutically.(Esselman et al., 2006) Pain can have serious effects on patient-perceived wellness as well; in a one-year follow up of lower-extremity fracture patients, the Visual Analogue Scale to measure pain was highly correlated (p<0.001) and independently associated with the Sickness Impact Profile (SIP), which measures the extent to which a patient perceives that their activity limitations are due to the injury.(Mock et al., 2000) Pain was also associated with a decrease in the ability to participate in leisurely pastimes and activities.(Anke et al., 1997) Decreased ability to interact in social settings or participate in certain activities is a potential reason for the increased feelings of depression and loneliness cited in several studies.(Anke et al., 1997; D. F. Zatzick et al., 2017)

COMORBIDITIES

Comorbidities frequently complicate injury patients recovery, indicating the important need for a holistic approach that considers more than just the immediate trauma. A study of over 75,000 injury patients in Washington state found that over 79% of patients had at least one comorbidity; 33.7% also were diagnosed with hypertension, 24.1% had ischemic heart disease, and 21.9% had pain-related disorders.(D. F. Zatzick et al., 2017) Comorbid conditions are indicated to affect patient recovery, affecting physical functionality and mobility, pain levels, and cognitive functioning.(Holtslag, van Beeck, Lindeman, & Leenen, 2007) While comorbidities in trauma have not been explored frequently in the literature, it is known that they are more prevalent in older populations and associated with an increased mortality.(Bergeron, Rossignol, Osler, & Clas, 2004) Besides older patients, another population potentially at a higher-risk of comorbid trauma are HIV-patients, who appear to have a higher prevalence of non-infectious comorbidities. One Italian study of antiretroviral therapy patients found that individuals with HIV had a higher likelihood of risk for non infectious comorbidities (bone fracture, renal failure, cardiovascular disease, diabetes, and hypertension), especially at younger ages.(Guaraldi et al., 2011) Comorbidities and subsequent treatment plans and outcomes for trauma patients is a growing field where further research is needed to fully understand the magnitude and implications of comorbid patients.

THE FIVE DOMAINS AND LMICS: A SYSTEMS APPROACH

In high income countries, the five domains of physical functioning, mental health, substance abuse, pain, and comorbidities have been shown to impact morbidity and mortality after an injury or hospitalization. The literature shows that many of these domains are interconnected, especially in the months and years following a traumatic injury. Research on the long-term care of trauma patients therefore needs to consider all five domains simultaneously and situated within their specific context parameters, to determine how to better improve patient outcomes and quality of life. Income level, social disparities and cultural beliefs dictates a society's dynamic structure thus influencing health management.

While most published research in this area is currently in high income countries, the effects are likely similar or more profound in LMICs, especially as populations in these countries are beginning to live longer and experience a subsequent increase in the burden of noncommunicable diseases. However, to fully comprehend the needs for a transition of care framework, it is imperative to understand the interaction between the individual and broader entities, such as the local community and governing

bodies. Therefore, we have incorporated the the systems approach proposed by the bioecological model of human development into our five domains model.(Bronfenbrenner, 1994)

The bioecological model defines context as structural layers that stem from from direct interaction with an individual (family, hospital, work environment) to passive interaction (culture, laws, governing systems). In our framework, we propose four layers that should be considered when conceptualizing the five domains as an implementation or a research framework (Figure 1). The first is the microsystem, involving any context with a direct activity by the individual (e.g. injury patient). The second is the mesosystem, marked by the institutional interaction involving directly the patient (i.e., family waiting in the hospital, work delayed by a disease). The third layer is the exosystem, indicated in Figure 1 as the community, referring to the entities or institutions where the individual has a passive participation (i.e., city level activities, hospital policies). The broadest layer is the macrosystem (culture), which encompasses the normative, cultural, and societal levels surrounding the individual and the other systems (i.e., national policies, media, and cultural beliefs). By integrating these layers into our five

domains, we can create our transition of care intervention framework that is uniquely adapted to the LMIC needs.

MEASURING THE 5 DOMAINS OF HEALTH MANAGEMENT

The 'five domains' model was conceptualized based on our previous efforts to describe post acute injury disability and impact on quality of life and span the main areas of disability. These domains were chosen due to their impact on outcome, their available validated assessment tools and the ease of facilitating tailored interventions in a care transition strategy. Assessment tools capable of describing our five domains are listed in Table 1. Each assessment tool was chosen based on validity either in a low and middle income setting, as well as feasibility for effective administration in an emergency department or trauma setting.

FUNCTIONALITY SCREENINGS

Functional Independence Measure (FIM) is an indicator of patient disability and was developed to track any changes in functional ability throughout rehabilitation care.(Functional Independence Measure, 2014) FIM was designed to be administered twice in one patient, once within 72 hours after the start of a rehabilitation program

Five Domains Assessment Tools	
Domain	**Evaluation Scales**
Functionality	Functional Independant Measure
Mental Health	CES-D
	PHQ-9
	SF-8
	Kessler Psychological Distress
Substance Abuse	AUDIT
	CAGE
	ASSIST
Pain	Validated Pain Scale
Comorbidities	HIV status
	Other conditions: diabetes, hypertension, renal failure, seizures

Table 1: Five Domains of Health Management Assessment Tools

and again within 72 hours before the end of the rehabilitation program. FIM is comprised of 18 ordinal scale items, each item is a task, the higher the score the more independent the patient is at completing the task. Of the 18 items, 13 items assess motor functioning and 5 items assess cognitive functioning.(Functional Independence Measure, 2014) FIM has been previously validated on various diseases including traumatic brain injury, stroke, back pain, spinal cord injury.(Dodds, Martin, Stolov, & Deyo, 1993; Stineman et al., 1996) Cross-cultural validation of FIM tested in various countries showed that cross-country comparisons are not accurate, but the use of FIM is valid within countries, for individual assessment.(Corrigan, Smith-Knapp, & Granger, 1997; Lawton et al., 2006; Riberto et al., 2004)

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Mental Health Screenings

Screening tools which can assess psychiatric and psychosocial events in patients from LMICs during rehabilitation post-injury are the following: CES-D; PHQ-9; SF-8; Kessler Psychological Distress. Due to the diversity of symptoms and effects associated with mental health, these four screening tools have been highlighted for assessment of the mental health domain.

The CES-D scale was designed to measure depressive symptoms in the general population.(Radloff, 1991) The scale consists of 20 items, each of which are depressive symptoms and patients rate the frequency for which they experience each symptom. The single score is calculated ranging from 0 to 60, a higher score indicating greater depressive symptomatology.(Center for Epidemiolgic Studies Depression Scale (CES-D)) CES-D was originally developed in the United States but has been validated in a wide-range of low to high income countries.(Batistoni, Neri, & Cupertino, 2007; Camacho et al., 2009; Lehmann et al., 2011; Opoliner, Blacker, Fitzmaurice, & Becker, 2014; Salinas-Rodríguez et al., 2014; Thai, Jones, Harris, & Heard, 2016; Zhang et al., 2015) Additionally the CES-D has been used as a measure of depressive symptoms amongst

injury patients.(Gordon, Cardone, Kim, Gordon, & Silver, 2006; Kim et al., 2007; Oyesanya & Ward, 2015; Rogers & Read, 2007; Stalder-Lüthy et al., 2013)

The PHQ-9 is a 9-item, self-administered questionnaire that is based on the 9 criteria used to diagnose depression according to the Diagnostic and Statistical Manual of Mental Disorders 4th ed. (DSM-IV) and is designed to diagnose and grade depression.(Kroenke, Spitzer, & Williams, 2001) As a self-administered tool, each patient marks 0, not at all, to 3, nearly every day, for each of the DSM-IV criteria.(Kroenke et al., 2001) PHQ-9 has been previously validated for injury patient populations (Fann et al., 2005; Phelan et al., 2010; Watnick, Wang, Demandura, & Ganzini, 2005; Williams et al., 2005) and has been validated in multiple countries.(Adewuya, Ola, Dada, & Fasoto, 2006; Lotrakul, Sumrithe, & Saipanish, 2008; Mueller et al., 2010; van Steenbergen-Weijenburg et al., 2010; Wulsin, Somoza, & Heck, 2002; Zhong et al., 2014)

SF-8 measures 4 physical and 4 mental health domains in order to assess a patient's well-being from the patient's perspective. The 4 physical health domains are: physical functioning; work function limitations; bodily pain; general health. The

4 mental health domains are: vitality; social functioning; work functioning caused by emotional problems; mental health.(SF Health Surveys, 2017) Each domain gets a score that can be interpreted through comparison to non-patient population scores.(SF Health Surveys, 2017) SF-8 has been translated in over 30 different languages and validated in a variety of patient populations as well as cross-cultural settings.(Lefante, Harmon, Ashby, Bernard, & Webber, 2005; Roberts, Browne, Ocaka, Oyok, & Sondorp, 2008; Shim et al., 2006; Tokuda et al., 2009; Turner-Bowker, Bayliss, Ware, & Kosinski, 2003; Valles et al., 2010; Ware, Kosinski, Dewey, & Gandek, 2001)

Kessler Psychological Distress Scale is an instrument used to assess psychological distress by asking patients how often they have experienced symptoms of psychological distress in the last 30 days. There are two versions of the original Kessler Scale - K10 and K6, the latter being an abridged version of the former.(Kessler et al., 2002) Factor analysis has shown to support Kessler as a valid measure for both anxiety and depression.(Arnaud et al., 2010; Bu et al., 2016; Fassert et al., 2009) The Kessler scale has been cross-validated to a variety of populations in low, middle, and high income settings.(Carra et al., 2011; Fassert et al., 2009; Lee et al., 2012; Oakley Browne,

Wells, Scott, & McGee, 2010; Patel et al., 2008; Sakurai, Nishi, & Kondo, 2011; Tesfaye, Hanlon, Wondimagegn, & Alem, 2010)

SUBSTANCE USE SCREENING

The screening tools to assess alcohol and use in patients from LMICs during their rehabilitative state are AUDIT and CAGE. The AUDIT's purpose is to predict an individual's hazardous drinking.(Fujii et al., 2016) The scale asks questions which evaluate alcohol dependence, hazardous, and harmful alcohol use.(Babor, 2001) The AUDIT is a 10-item self-reported scale [range 0-40].(Anderson, 2001) The WHO designed the AUDIT to aid in the screening of excessive drinking, and standardized the scale for six countries: Norway, Australia, Kenya, Bulgaria, Mexico, and the United States of America.(Babor, 2001) Since then the AUDIT has been validated and used among injury populations.(Conrad, Hansel, Pejic, & Constans, 2013; Lotfipour et al., 2010; Wade, Varker, Forbes, & O'Donnell, 2014)

The CAGE survey is a four item questionnaire that like the AUDIT is designed to screen for alcohol dependence and misuse; it is frequently used in clinical settings.(Ewing, 1984) The CAGE has been

translated into many different languages and validated in a variety of country settings.(Kebede & Alem, 1999; Meneses-Gaya et al., 2010; So & Sung, 2013; Weiss et al., 2016; Wu et al., 2008)

Substance use can be assessed using the World Health Organization's Alcohol, Smoking, and Substance Involving Screening test (ASSIST). This instrument is an eight-item assessment administered to patients by an research administrator or healthcare provider that covers usage of ten substances: tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants (ATS), inhalants, sedatives, hallucinogens, opioids and 'other drugs'.(The ASSIST project-Alcohol, Smoking and Substance Involvement Screening Test, 2013; Humeniuk et al., 2008) Risk level for mental, social, health, and financial-related issues as a result of currently substance usage is assessed for each of the ten substance based on the cumulative score in each section and subsequently categorized as low, medium, or high.(The ASSIST project-Alcohol, Smoking and Substance Involvement Screening Test, 2013)

PAIN

Pain is a condition that can compound other aspects of health and affects functionality,

substance use, and mental health. The visual analogue scale (VAS) has been validated as a useful tool for measuring both chronic and acute pain as well as pain intensity.(Bijur, Silver, & Gallagher, 2001; Bird & Dickson, 2001; Jensen, Chen, & Brugger, 2003) VAS is a single item self-assessment; the respondent places a mark perpendicular to the 100mm VAS line indicating pain intensity occurring in the last 24 hours. 0 mm indicates "no pain" and 100 mm indicates "worst imaginable pain."(Hawker, Mian, Kendzerska, & French, 2011) There is limited data on validation of VAS in low-income settings; however, there is some research that shows it to be culturally sensitive and still an effective measure of self-reported health and pain in LMICs.(Baltussen, Sanon, Sommerfeld, & Würthwein, 2002; Blomstedt et al., 2012)

COMORBIDITIES

The last health domain to be included are the patient's comorbidities. An individual patient's comorbidities will be screened through a questionnaire that simply highlights the patient's existing conditions. This questionnaire should be tailored to include diseases particularly endemic in the region. Conditions of note would be any infectious diseases including, HIV and TB, and non-communicable diseases including

diabetes, hypertension, and renal or heart failure.

Case Study: Pilot Work in Tanzania

CONTEXT AND INFRASTRUCTURE

Kilimanjaro Christian Medical Center (KCMC) is the third largest hospital in the country, is the referral hospital for north-western Tanzania and is a regional training center for all types of health care professionals.(Staton et al., 2016)KCMC is located in Moshi, Tanzania, a city of less than 200,000 people but serves the surrounding regions of over 11 million people.(Staton et al., 2016) KCMC is a 450 bed hospital with subspecialized surgical capacity, including minor neurosurgeries performed by general surgeons and intensive care capacity. KCMC has advanced intensive care, orthopedic, rehabilitative and occupational therapy departments with a limited number but well trained personnel. The leading cause of death in Tanzania is HIV related diseases which mirror's KCMC's most robust research and clinical infrastructure which focuses on pediatric and adult HIV. The estimated burden of TBI at KCMC is staggering: approximately 6% of all emergency department (ED) visits, or about 1000 patients annually, present with a TBI. Approximately 500 patients are admitted to

the intensive care unit (ICU) annually, of which 57.1% suffer fatal injuries.(Mortality in the KCMC Intensive Care Unit, 2012; Staton et al., 2017) Regional data suggests one third of patients in the ICUs suffer from TBI, and TBI is the most common neurosurgical process presenting to hospitals. (Mortality in the KCMC Intensive Care Unit, 2012; Winkler, Tluway, Slottje, Schmutzhard, & Härtl, 2010) KCMC has a newly established and fully equipped Emergency Medicine department, yet lacks any Emergency Medicine trained physicians. There is a CT scan available at the hospital that functions about 75% of the time due to technical and electrical issues. At this partially non-profit, partially governmental regional referral center, healthcare costs are partially subsidized by the government but patients are required to pay for their 'chart' or registering as a new patient, diagnostics, and treatments.

It is especially challenging to address injury in settings like Tanzania, for instance, where HIV is the leading cause of years of life lost and the resultant focus of resources.(Whiteford et al., 2013) Yet, the two conditions do not have to be viewed independently, as supported by literature on the presence of comorbidities in trauma patients.(Bergeron et al., 2004; Guaraldi et al., 2011; Holtslag et al., 2007; D. F. Zatzick

et al., 2017) In Northern Tanzania, the injury population has HIV rates of 11.6% compared to the general community rates of 4-6%.(Mayala, Mshana, Chalya, Dass, & Kalluvya, 2010) Adults who suffer injuries have a higher risk for HIV as since these conditions share high risk behaviors. For example, in Tanzania, 15-27% of injured patients and 20% of HIV populations have high risk-alcohol use.(Alim et al., 2006; Francis et al., 2015; Gillespie et al., 2009; Honkanen, 1993; Mayala et al., 2010; Medley et al., 2014; Whetten et al., 2013) Currently research is limited on both the prevalence of HIV among trauma patients as well as the complications caused by the double burden of injury and HIV, especially in Tanzania.

Four years ago, a traumatic brain injury registry at Kilimanjaro Christian Medical Center (KCMC) in Moshi, Tanzania was designed to include all patients presenting for treatment of acute head injuries. Data collection from patients includes demographic, injury, provision of care and clinical health status information over time. If patients met inclusion criteria, they were offered enrollment in the study. While the registry doesn't require informed consent, any follow-up studies require a full written informed consent. After providing informed consent, surveys are administered in the

local language. Subjects unable to provide consent due to injury or intoxication were enrolled by Legal Authorized Representative (LAR) and then re-consented when he/she regained capacity to consent. The current registry includes patient demographics and data about acute presentation, treatment, procedures, complications, and discharge status. The severity of injury is determined by the physiologic Revised Trauma Score, the Glasgow Coma Score, and the Kampala Trauma Score (KTS).(Moore, Lavoie, Camden, et al., 2006; Moore, Lavoie, LeSage, et al., 2006; Weeks et al., 2016) (Oluwadiya, Popoola, & Oginni, 2010)

5 Domains of Health Management Implementation

Over the past two years, we have collected data on injury patients at KCMC, including 9-months of follow-up post-hospitalization. Based on these findings at KCMC and literature that supports the five domains, moving forward we plan that the KCMC registry will be expanded to include all injury patients and additional measures of the care provided during the acute hospitalization (e.g., patient education, assessments of risk behaviors, etc.) and in the community after discharge (e.g., follow-up, family provided care or support for activities of daily living). All five domain of

health evaluation scales will be administered at enrollment and follow-up periods.

PHYSICAL FUNCTION

We followed over 200 injury patients for nine months after their acute injury to assess their physical disability after discharge from the hospital. In our population, physical disability was highest at discharge post injury (30%) and is still present nine months after injury in 4% of cases. Specifically regarding TBI patients, our registry data collected between May 2013 and April 2014 found an average score Glasgow Outcome Scale-Extended (GOS-E) of 13.3 (SD: + 3.3, IQR: 14-15), with 13% suffering from a severe TBI (GCS < 9) and 75% from a mild TBI (GCS > 13(Staton et al., 2017).

MENTAL HEALTH

We have started our mental health domain implementation by validating four outcome measures for the Tanzanian culture and in Swahili. The PHQ-9, SF-8, CES-D and Kessler Psychological Distress scale all showed adequate fit indicators and are suitable for the injury population. Mental health assessments post-hospital discharge indicate 14% have mental health complications (8% of which is anxiety) and

14% have limitations in quality of life. Our results also show that depression increase over time, but quality of life is worse immediately following the injury and tends to improve over time. Now we are associating this indicators with clinical characteristics to see what is the impact of mental health on recovery and what are the rehabilitation needs of Tanzanian acute injury patients.

This data helped shape our target for intervention focusing mainly on depression. Moving forward we have developed a framework to implement and validate a long distance mobile surveillance for depressive symptoms across injury patients using text messaging. This project will help tailor a remote surveillance system for our transition of care model focusing on each of the five domains of health management. Also, we have established a community therapy intervention based on the Integrative Community Therapy framework using sports practice as a mental health and physical functioning reintegration strategy. Currently, this project is been piloted in Brazil with a TBI population.

SUBSTANCE USE

Data was collected for two separate cohorts of injury patients and traumatic brain injury

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patients, with 28% and 27% of patients, respectively, testing positive for alcohol usage via self-report, breathalyzer testing or physician exam. More concerningly, within our most current cohort of injury patients, 35% of non-abstainers from alcohol, who comprised 24% of all trauma patients, have an AUDIT score >8. This score indicates harmful and hazardous drinking behavior, which is found to persist beyond hospitalization, with 19% of patients scoring >8 on the AUDIT 6 months post-injury. We conducted focus groups in order to define current practices of alcohol reporting, perspectives on alcohol use, and how stigma against alcohol might impact report and treatment seeking behavior.

Moving forward, we will continue to use the AUDIT screening while also incorporating the CAGE questionnaire for alcohol use and the ASSIST tool for drug and other substance usage. These tools will allow us to obtain a more comprehensive picture of substance usage post-injury, and as reported previously, there is a great deal of literature that supports both the validity of these tools and the importance of monitoring substance usage post-injury. While ASSIST has not been validated in Tanzania, it has been validated in internationally and in other low-income countries, including the neighboring country of Zambia.(Humeniuk et al., 2008) At the same time, we are creating and validating a brief intervention for alcohol use that will be administered to those with harmful and hazardous drinking. This intervention will be applicable for alcohol but we hope to adopt it for use for other substances as well.

Pain

Of the trauma patients we have followed up with so far, 14% have persistent pain. The comorbid burden of pain with the other domains of mental health and substance usage has not yet been examined. Inventories of treatment options have been kept in order to inform a standard pain medicine routing which can be implemented both during hospitalization for pain related complaints as well as post hospitalization pain.

In our future work, we will have patients complete the VAS while also completing the ASSIST, CAGE, AUDIT, CES-D, PHQ-9, SF-8, and Kessler Psychological Distress to provide a holistic picture of their pain levels, mental health, alcohol usage, and presence of any substance abuse. The BNI as well as development of a comprehensive transition of care plan will allow us to monitor pain levels and the relationship with the other four domains of health.

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	Current Progress	Next Steps	Validated Assessments	Protocol Deviation
Physical Function	- Injury patients registry - 9 month longitudinal study - Health outcome tool validation	-Healthcare practitioners KAP - CPG implementation for injury acute care	- FIM to Tanzania and Swahili ongoing	- >5000 injury patients enrolled in 4 years - *Longitudinal study of 200 patients, 58% completed the full protocol (3 or 4 follow ups), 19% completed 1 or 2 follow up periods and 24% were lost to follow up - High proportion of patient elopement resulted in us obtaining a second contact (approved family or friend) to provide accurate information
Mental Health	- 9 month longitudinal study - Health outcome tool validation	-Improving surveillance with mHealth technology - Community therapy for mental health reintegration	- PHQ9 to Tanzania and Swahili ongoing - CES-D to Tanzania and Swahili ongoing - Kessler to Tanzania and Swahili ongoing - SF8 to Tanzania and Swahili ongoing	
Substance Use	- 9 month longitudinal study - In depth alcohol use and consequences surveys for patients and families - Health outcome tool validation - Qualitative studies about alcohol use	-Brief intervention for alcohol use at the emergency department -Validation of a comprehensive tool of drug use -Assessing perceptions of alcohol use -Assessing reporting practices of alcohol use	- AUDIT to Tanzania and Swahili ongoing - Perceived Devaluation and Discrimination	- Longitudinal study * above - 100% are participating in screening process for our intervention - High alcohol stigma identified among healthcare professionals
Pain	- Patient surveys on pain	- Validating a VAS for Pain assessment at the Emergency Department	VAS for pain	ongoing research
Comorbidity	to start	- Evaluating infectious comorbidities including HIV - Evaluating non infectious comorbidities including hypertension, diabetes, renal and cardiac disease	to start	ongoing research

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COMORBIDITIES

Currently at KCMC, there is no registry that identifies injury patient comorbidities. We plan to expand our registry to evaluate for hypertension, diabetes, renal disease, heart disease, and infectious comorbidities such as HIV. This information will be used to further community based management of comorbidities, obtaining appropriate follow up care and referrals as well required medicines.

Conclusion

As acute traumatic injury can have long-lasting consequences, including changes in physical functioning and permanent disability. Chronic or disabled patients are additionally at higher risk for mental health impairments that increased physical and mental disabilities, increased risk for comorbidities, and increased likelihood of not adhering to medication. Injuries are a leading cause of disability, particularly in LMICs, and all five health domains must be addressed in order to provide a comprehensive care transition plan for patients to reduce comorbidities and risk for a decline in both psychological and physiological health. Each can interact leading to the need for a systemic approach to simultaneously address them holistically.

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