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Discovering the Current Wound Management Practices of Rural Africans: a Pilot Study

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Discovering the Current Wound Management Practices of Rural Africans: a Pilot Study

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Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas Medical Branch

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas Medical Branch

May, 2013

Dedication

This research is dedicated to the stalwart individuals who work tirelessly, with few resources and little thanks, providing wound care in rural areas of tropical developing countries.

It is not good to have zeal without knowledge, not to be hasty and miss the way.

- Proverbs 19:2 (NIV)

Acknowledgements

This journey began at an educational conference for wound specialists, when Dr. Patti Smith, moved by my poster on teaching wound care to village health workers, convinced me that I needed to focus again on this important work. My decision to pursue my PhD in Nursing Education stems from an overwhelming conviction that I am a teacher, and I need to do what is necessary to provide sound, appropriate educational materials for village health workers.

The UTMB Nursing PhD Faculty have consistently been supportive and encouraging as I pursued my goals, allowing me to write on the topics I feel most strongly called to pursue (village health workers and wound care) for many of my course assignments. This allowed me to complete much of the preliminary work for this dissertation before I took my first qualifying exams. Each one of my five dissertation committee members has offered excellent suggestions, providing guidance with grace. Dr. Carolyn Phillips, Dr. Cheyenne Martin, and Dean Watson have also been my cheerleaders, mentors, and advocates.

This research study would not have been possible without the support of a great many prayer warriors, donors, family members, participants, interpreters, and friends, both in the USA and in Ghana, for whom I am most grateful. Niipaak Laar and Christian & Lizzie Nsoah helped to smooth the road before us, and Dr. Peter Bombande provided encouragement, hospitality, and Puddleglum, the little blue truck who complained often, but did not fail in times of need.

Special thanks goes to my husband, partner, and research assistant of the century, Richard Benskin, who cheerfully does whatever needs to be done and then does more.

Discovering the Current Wound Management Practices of Rural Africans: a Pilot Study

Publication No._____

Linda L. L. Benskin, PhD

The University of Texas Medical Branch, 2013

Supervisor: Sheryl L. Bishop

Abstract

Unrelenting heat, poor sanitation, lack of knowledge, and poverty contribute to a disabling wound prevalence that often exceeds 20% in rural areas of tropical developing countries. Wounds in this environment are usually poorly managed at very high cost. Traditional health practitioners and village health workers, rather than health professionals, provide health care in most villages. Wound management education for these nonprofessional health providers should include only sustainable practices which prove to be safe and effective in tropical villages. However, usual practice data, needed for comparison studies, is absent from the published literature.

This pilot study introduced an innovative data collection method to overcome cultural obstacles which have prevented researchers from obtaining meaningful quantitative data in this challenging setting. Between August and October of 2012, seventy-five participants from 25 diverse villages in Ghana provided detailed descriptions of their current usual topical wound management methods by completing the stories of patients representing each of seven wound types commonly found in this setting. Responses were tabulated and categorized as congruent or not congruent with modern topical wound management principles within three domains and six subcategories (two for each domain).

Four research questions organized the data analysis. The wound management practices of nonprofessional health care providers were identified and described in detail for the first time. These results are foundational to the process of developing culturally and environmentally appropriate wound management protocols for indigenous wound care providers in rural areas of tropical developing countries. In addition, several significant differences in the wound management of the three nonprofessional provider groups were found.

The unique data collection method introduced in this study can easily be adapted to rural areas of other tropical developing countries. When sufficient data have been accumulated, the information can be utilized to design comparison studies so that the ecological validity of the wound management protocols in planned educational programs can be ensured.

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List of Abbreviations

BPP	Boiled Potato Peel
CINAHL	Cumulative Index to Nursing and Allied Health Literature
FTP	File Transfer Protocol (for moving large files over the web)
GSBS	Graduate School of Biomedical Sciences
PI	Principal Investigator
RA	Research Assistant
SPSS	IBM's Statistical Product and Service Solutions software
THP	Traditional Health Practitioner
UTMB	University of Texas Medical Branch
VHW	Village Health Worker
VSC	Villager who provides wound Self Care
WHO	The World Health Organization

CHAPTER 1: INTRODUCTION

This chapter introduces the problem of wounds in rural areas of tropical developing countries. Background information explains why this is a timely topic, particularly for nurse educators. The chapter then establishes the significance of the wound management problem in tropical developing countries worldwide. It traces the evolution of wound care to current modern wound management practices. The chapter ends with a brief description of this pilot research study and its implications.

The definition of *wound* for the purpose of this research study is a physical break in the skin. The wounds included in this research extend beyond the epidermis at least into the dermal layer of the visible skin. Based upon articles by Bolton (2007), Macdonald and Asiedu (2010), and others (e.g., Laforet et al., 2011; Macdonald & Geyer, 2010, p. 1; Sibbald, et al., 2011), interventions consistent with *modern topical wound management* principles are, for the purposes of this study: cleansing the wound bed with a noncytotoxic substance (as opposed to no cleansing, or cleansing with cytotoxic substances); debridement of nonviable tissue (as opposed to removing viable tissue, or failing to address nonviable tissue); applying substances, wraps, elevation, heat and cold, etc., which keep the wound appropriately moist, decrease infection, and augment circulation by controlling edema/lymphedema and inflammation (as opposed to applying harmful treatments or failing to address infection, swelling, and/or inflammation); and applying covers which are moisture-balancing, help prevent further trauma, and seal against contaminants.

Problem

The prevalence of disabling wounds often exceeds 20% in rural areas of tropical developing countries (Gibbs, 1996; World Health Organization [WHO], 2005, p. 6). Villagers are usually out-of-doors all day wearing minimal protective clothing. Biting insects and microorganisms abound. Cuts, scrapes, burns, and puncture wounds are an inevitable consequence of physical labor such as farming, fishing, and preparing meals with primitive tools. Wound management in rural areas of tropical developing countries is costly and largely ineffective (WHO, 2005, pp. 9, 12). Poor sanitation, lack of knowledge, and poverty contribute to delayed wound healing.

Health care providers in rural areas of tropical developing countries need to be taught how to provide safe, efficacious, affordable wound care (Ryan, 1990, 2008; WHO, 2005, pp. 39, 40). Before implementing a teaching program, comparison trials should validate the proposed wound management protocols in the tropical village setting to establish ecological validity (Gliner et al., 2009, p. 129). However, so little is known about current usual wound management practices in rural areas of tropical developing countries that a comparison trial could not be designed.

This pilot study was designed to discover the usual current topical wound management practices in villages throughout Ghana, West Africa. Data from this descriptive research study and additional studies based upon this template can be used to design comparison trials, building an evidence base upon which to develop much needed protocols for wound management in rural areas of tropical developing countries.

Background

Over one billion of the 1.4 billion people who live in extreme poverty (defined as less than US $1.25/day) reside in rural areas of developing countries (Shah, 2011). Data on the efficacy of wound management choices that are available to these individuals is extremely scarce (WHO, 2005). Tropical wound expert Terence Ryan (2008) asserts that despite the potentially "life threatening" consequences of mismanaged wounds, this area of health care in the developing world is a "shamefully neglected" subject of study (p. 205). For example, in the reference book, *Disease Control Priorities in Developing Countries, 2nd edition*, discussion of wound management is limited to one chapter (Skin Diseases), which emphasizes superficial rashes (Hay et al., 2006). With respect to tropical ulcers, Hay et al. (2006) state, "In searching the literature for effective remedies for tropical ulcer, the team found little evidence . . . . no randomized controlled trials have been performed." (p. 717). The book is silent about treatment for wounds which are not typically treated by dermatologists, such as burns, trauma wounds, and ulcers caused by pressure, venous insufficiency, or diabetes. The most recent edition of the WHO's comprehensive report, *The Global Burden of Disease* includes gastric ulcers and periodontal disease, but completely omits visible wounds (WHO, 2008).

The tendency to overlook the wound problem is not universal. Historically, tropical dermatologists have addressed the need for improved wound management in developing countries by educating indigenous urban-based health professionals (Ryan, 2009). British nurse educators, working as part of a

team, dramatically improved wound outcomes by teaching indigenous nurses and surgeons in major hospitals in Ghana and Ethiopia basic infection control measures (Mewburn, 2005). In late 2009, the World Alliance for Wound and Lymphoedema Care (WAWLC) formed a new partnership with the WHO to teach modern wound management principles to indigenous health professionals in developing countries (Macdonald, 2010, 2011; Macdonald & Asiedu, 2010). The University of Toronto has recently started teaching wound management to health professionals from several African and South American countries through the International Interprofessional Wound Care Course (Sibbald et al., 2012).

These efforts to teach health professionals are commendable. However, health professionals are usually absent in rural areas of tropical developing countries. Up to 90% of the population in developing countries uses traditional medicine to help meet their primary health needs (WHO, 2002). Wounds in rural areas of developing countries are often treated by traditional health practitioners (THPs), by self-care with traditional medicine or drugs (VSCs), or by road-side drug peddlers (Ryan, 2006). Minimally trained village health workers (VHWs) provide basic scientifically-verified curative care and promote health in many rural areas where health professionals are not readily available (Bender & Pitkin, 1987; Benskin, 2012a). The perceived source of the wound informs the decision of whom to consult for a cure (Degrémont et al., 1987). When VSC fails or is deemed inadequate, THPs and VHWs, rather than health professionals, provide health care in most villages (Benskin, 2012a; Ryan, 2006; Ryan et al., 2011). Experts agree that achieving effective wound management in rural tropical areas

of developing countries will require educating the VHWs, THPs, and VSCs who provide health care in these areas (Benskin, 2009; Figueroa et al., 1998; Ryan, 2006; Schmeller & Dzikus, 2001).

Role of Nurses

Wound Ostomy Continence Nurses are the most highly trained certificants of all the health care professionals in the wound care specialty area (Rappl et al., 2007). Of the medical professionals, it is nurses who spend the most time caring for the skin (Ryan, 2007). Nurses are also the health professionals who usually teach and supervise the VHWs who provide wound care in their communities (Benskin, 2012a; Liu et al., 2011; Quillian, 1993). This places wound specialist nurses in a unique position to address the problem of inadequate wound management in rural areas of tropical developing countries.

Significance of the Problem

Wound management is a significant problem in rural areas of tropical developing countries due to the large number of individuals affected, the burden the problem places on the limited health resources available in these areas, the lack of effective treatments, and the consequences of inappropriately managed wounds for patients and their families.

Prevalence

An exhaustive search for literature specific to the prevalence of wounds in developing countries led to only a few studies, all of which were for wounds with a specific etiology, such as Buruli Ulcer, yaws, or Guinea worm. Wound prevalence data for rural areas of developing countries, however, can be

extracted from detailed broader prevalence studies. A plethora of skin disease prevalence studies were performed by dermatologists in rural areas of developing countries in the 1970's (WHO, 2005). These studies often excluded entire wound categories, such as ulcerations and burns. However, they show that purulent skin disease, which dermatologists classify as pyoderma, is by itself a significant health problem in developing countries, particularly in tropical areas.

Taplin and colleagues (1973) studied four areas of Columbia, finding that a tropical climate was associated with five times more bacterially-infected skin wounds than a cool environment. *Staphylococcus aureus* and *Streptococcus pyogenes* were cultured from most of the wounds. The researchers reported a bacterially-infected pyoderma prevalence rate of 38% among soldiers in the jungle environment (Taplin et al., 1973).

When infected scabies is excluded, pyoderma rates appear to be unrelated to socioeconomic or hygienic conditions (Masawe et al., 1975). Mild trauma wounds such as bites, scratches and nicks become infected as flies feed on them in warm moist climates, but evidence suggests that biting insects also disseminate streptococci and other ulcer-forming organisms directly (Allen et al., 1971; Belcher et al., 1977; Hare, 1948; Taplin et al., 1973). Streptococcal and staphylococcal pyodermas are so prevalent in the rural tropical developing regions of Southeast Asia, South America, and Africa that pyoderma has been described as an epidemic (Allen & Taplin, 1974).

The 1975 Village Health Survey in Ghana found a 19.4% prevalence of pyoderma in villagers, with a rate of over 35% for school-aged boys (Belcher et

al., 1977). Of the 732 pyoderma sufferers in the survey, 21% developed deep ulceration and 13% developed cellulitis (Belcher et al., 1977). Even among well nourished adults, up to one third may be incapacitated by pyoderma (Allen et al., 1972; Taplin et al., 1973). Bacterial pyodermas ("jungle sores") were often the leading cause of disability among American soldiers in the jungle areas of Vietnam (Allen et al., 1971; Allen et al., 1972). Although many of these studies are decades old, more recent dermatological prevalence studies confirm that pyoderma rates have not declined (Henderson, 1996; WHO, 2005).

Burden on the Health Care System

The sheer volume of wound patients and the large amount of time required to care for each wound overwhelms the limited health care resources in developing countries worldwide. Walker and colleagues (2008) reported that skincare is the primary reason for patient visits to health service centers in a rural tropical area of Nepal. Nigerian VHWs spent more of their time dressing ulcers than treating any other ailment (Wyatt & Wyatt, 1967). Almost one third of all visits to rural southeastern Tanzanian village health posts were for wounds (Degrémont et al., 1987). When every child in these Tanzanian villages was examined by doctors, 10% were found to have infected skin ulcers (Degrémont et al., 1987). In one province of Papua New Guinea, treatment of chronic skin ulcers alone accounted for up to 6480 aid post patient visits per year (Morris et al., 1989).

Lack of Efficacy of Wound Management

Throughout the tropics, wound care in rural areas is ineffective. Traditional

medicine, utilized most often by THPs and VSCs, is often not efficacious for wound management, and VHWs are not always trained or equipped to handle pyoderma (Mahé et al., 1995). Stock (1983) found that tropical ulcers did not respond to Nigerian traditional herbal remedies. A study in rural Ethiopia found that 20% of children with skin diseases had gone to the THP or the health center (VHW) for treatment which was unsuccessful (Figueroa et al., 1996). Hay and colleagues (1994) found that villagers in Mexico spent a high percentage of their household income on ineffective treatment for skin diseases, primarily pyoderma. Ethiopian patients with skin diseases spent between 50% and 100% of their cash income on treatment with drugs or local remedies, 63% to 74% of which were ineffective (Figueroa et al., 1998).

Researchers examined every individual in randomly selected households of two rural Tanzanian villages (Gibbs, 1996). The study included only major wounds and rashes that had been present at least three weeks, defining a skin disease as an obvious skin alteration that was nontransient, symptomatic, disfiguring and could be reasonably presented to a practitioner for treatment (Gibbs, 1996). When they searched for reasons why only 10% of the sufferers actually sought treatment, the researchers found that the local hospital had no topical skin preparations and usually did not even have wound dressings available, and the indigenous healers were reluctant to treat skin diseases because they did not have very effective treatments (Gibbs, 1996). The researchers attributed the 26.9% prevalence of significant skin disease in this area to lack of effective treatment (Gibbs, 1996).

While chronic wounds in developed countries are usually the result of an underlying chronic condition, such as diabetes or venous insufficiency, in the developing world chronic wounds usually originate from poorly managed acute wounds (Gupta et al., 2004; Oluwatosin, 2007). Researchers in Ghana explained this phenomenon, noting that wound complications such as cellulitis and ulceration, "…frequently occurred because of inadequate treatment, environmental conditions, and traditional medicine applications." (Belcher et al., 1977, p. 204). Impetigo and more serious wounds, such as tropical ulcers, resolve much more quickly when systemic antibiotics are included in the treatment (Allen et al., 1972; Kuberski & Koteka, 1980; Taplin & Allen, 1974). However, in the developing world, uneducated shopkeepers are the primary source of systemic antibiotics, which are usually supplied in inadequate dosages (e.g., Geissler et al., 2000). Haphazard dispensing of medications results in lack of efficacy, drug resistant bacteria, and in some instances, fatal overdose (Geissler et al., 2000).

Consequences of Ineffective Wound Management

Wounds are not only the most common cause of morbidity in the tropics, but due to the prevalence of β-hemolytic streptococci in wounds, they are a common precursor of post-streptococcal glomerulonephritis (Acheampong et al., 1988; Lehmann et al., 2003; Masawe et al., 1975; Taplin & Allen, 1974; WHO, 2005). This potentially fatal complication makes it important to treat pyoderma in children with systemic antibiotics (Taplin & Allen, 1974; Koning et al., 2009). Inadequately treated streptococcal pyoderma can also progress to rheumatic

heart disease (Koshi et al., 1981).

Glomerulonephritis from pyoderma occurs almost exclusively in children, three weeks or more after the skin infection (Whittle et al., 1973). Schoolchildren with skin lesions in a rural area near Lagos, Nigeria were examined by researchers; 89.4% of their lesions were positive for β-hemolytic streptococci (Lawal et al., 1990). Because β-hemolytic streptococci are a common precipitating organism, the prevalence of pyoderma decreases with age as partial immunity develops (Allen et. al., 1972; Allen et al., 1971). This helps explain why children develop pyoderma at twice the rate of adults (Allen & Taplin, 1974; Bulto et al., 1993).

A significant number of children in the tropics are at risk for complications of pyoderma such as glomerulonephritis and rheumatic heart disease. Porter (1980) excluded infected scabies bites and still found that in the rainy season 16.8% of Gambian children under age 10 had pyoderma. Even during the dry season, 12.3% of children in Mali had pyoderma; over half of the wounds were chronic (Mahé et al., 1995). At a rural health center in India, pyoderma was the most common diagnosis for children less than three years old, affecting 23.65% of these patients (Kapil & Sood, 1989).

Wound mismanagement has serious consequences for adults as well. Significant wounds prevent the sufferers from working, which can have dire consequences for entire families (Macdonald & Asiedu, 2010; Ryan, 1990). Pain from tropical ulcers, in particular, is often severe enough to immobilize the sufferer (Robinson & Hay, 1986). Morrone (2008), an advocate for education for

VHWs and patients, contends that the greatest disability caused by wounds is that of being unwelcome. Heavily exudating or foul-smelling wounds can make it impossible for patients to socialize even with family, and can prevent patients from taking public transportation to treatment facilities (Renzaho et al., 2007). Marjolin's Ulcer Carcinoma, which develops from wound scars, is common in the tropics (Asuquo et al., 2007; Nthumba, 2010). Chronic ulcers may also become cancerous (Asuquo et al., 2007; Robinson et al., 1988; WHO, 2005, p. 20).

Study Overview

Theoretical Framework: Modern Wound Management

Wound management recommendations have changed dramatically in the past century. Ovington's (2002b) history of scientifically-validated wound care states that thousands of years ago Egyptians treated wounds with dressings comprised of vegetable fibers for absorption, honey as a hydrophilic antibacterial agent, and grease to keep out contaminants. The ancient Greeks, including Galen, also recognized that moisture aids wound healing (Ovington, 2002b). In the Renaissance, wound management evolved as the benefits of cleansing and debridement were discovered, but dressings remained relatively unchanged (Ovington, 2002b). The discovery of bacteria, germ theory, and antiseptics in the 19th century led to handwashing protocols and iodoform cotton gauze dressings (Ovington, 2002b). Other antimicrobial dressings followed, and the advantages of keeping wounds moist were overlooked (Ovington, 2002b).

Microbes thrive in warm moist environments, leading to the common belief that wounds must be dressed in a way that allows them to dry up, or "breathe" to

avoid infection, a practice that persists to this day (Jones, 2006; Hutchinson & McGuckin, 1990). During World War II a British medical officer in a prisoner of war camp determined that cellophane, a semipermeable membrane, was far superior to porous petrolatum gauze in supporting the healing of burn wounds among his fellow prisoners (Bloom, 1945). Captain Bloom (1945) found that moisture-retentive cellophane kept infectious organisms out of the wound bed, kept the body's healing nutrients in the wound bed, permitted excess moisture to escape, and dramatically decreased pain. In 1948, Gilje, a Swedish doctoral student, found that occluding wounds with adhesive tape dramatically sped healing (Jones, 2006; Ovington, 2002b). However, these discoveries did not result in clinical practice changes (Ovington, 2002b).

Two decades later Winter (1962) proved experimentally that when wounds are covered with moisture-retentive dressings, they heal much faster than wounds open to air. Moisture allows the healing cells of the body to migrate more freely and gives them access to nutrients (Winter, 1962, 2006). Winter's dramatic studies were timely, helping to give birth to the new health specialty of wound care, predicated on the revolutionary idea that moist wound healing is the ideal (Jones, 2006; Jones and San Miguel, 2006; Ovington, 2002b). Manufacturers have capitalized upon the growing demand for products which support moist wound healing, leading to an exponential growth in wound dressing choices (Ovington, 2002b). Unfortunately, these modern dressings are not widely available in the developing world (Benskin, 2011; Gitarja, 2010; Ryan, 2008). However, applying modern wound healing principles is not dependent upon the

use of commercial dressings (Bolton, 2010; Laforet et al., 2011; Ovington, 2002b). As was previously discussed, the Greek physician, Galen, kept wounds moist prior to 200 A.D. (Ovington, 2002b).

Purpose and Goals

The aim of this pilot study was to characterize usual topical wound management practices in rural areas of a tropical developing country: Ghana, West Africa. Topical wound management was evaluated with descriptive statistics and compared across provider groups and across wound types.

Seven representative actual wound case studies were used to guide carefully constructed interviews in order to determine the usual topical wound management practices of three health care provider groups: THPs, VHWs, and VSCs, in twenty-five rural areas throughout Ghana over a period of 3 months (August – October, 2012). The discrete wound management practices of the 75 participants for each of the seven wound types were identified from the recorded interviews and organized based upon modern wound management principles, subdivided by domain and subcategory.

The three *domains* of modern topical wound management for the purposes of this study are: (I) wound bed preparation techniques (methods of cleansing and debridement), (II) wound treatments (salves, ointments, powders, poultices, wraps, elevation, heat and cold, etc., used to decrease infection, balance moisture, and control edema/lymphedema and inflammation), and (III) wound dressings (commercial or indigenous). The six *subcategories* (two under each domain) are: Cleansing (IA), Debridement (IB), Infection/Moisture Control

measures (IIA), Inflammation/Edema Control measures (IIB), Commercial dressings (IIIA), and Indigenous dressings (IIIB).

Research Questions

1) What are the defining characteristics of the wound management practices of THPs, VHWs, and VSCs in rural areas of Ghana?

2) What are the similarities and differences between wound management *subcategories* performed by each of these three provider groups across the seven different wound types?

3) What are the similarities and differences between wound management *domain* practices performed by each of these groups across seven different wound types?

4) Are there differences in provider practice at the subcategory or domain level with respect to *wound type*?

Design Overview

The discrete wound management practices of the participants for each of the seven wound types were identified from recorded interviews and entered into SPSS for quantitative data analysis, organized by three topical aspects (*domains*) of modern wound management: wound bed preparation, wound treatments, and wound dressings. The overall response for each wound case for each participant, informed by the rationale given by the participants for their choices, were categorized as congruent or not congruent with modern topical wound management principles based upon Bolton (2007) and Macdonald and Asiedu (2010). Identified dependent variables include the *frequency* of responses

of wound practices (Appendix A) at the nominal level (yes/no), as well as four aggregated indices: wound management subcategory practices (WndSub), wound management domain practices (WndDom), and wound type-specific practices for subcategories (SubType) and domains (DomType).

Question (1) was addressed by summarizing the nominal data at all levels using descriptive statistics (modes, percentages), and frequency distribution graphs. The three-factor between-groups comparative study design allowed the independent variable (VHW, THP, or VSC) to be compared across aggregated indices (WndSub, WndDom, SubType, DomType) using inferential statistics to address questions (2), (3), and (4). Analyses of variance (ANOVA) were used to determine if there are differences between provider groups at the subcategory level (RQ2), or domain level (RQ3), or if any of the wound types are more likely than the others to be managed in conformity to modern topical wound management principles (RQ4).

Implications of Study

Various organizations develop and implement educational programs for nonprofessional health providers in rural areas of tropical developing countries. The wound component of these educational programs should include only practices which are safe and effective in the tropical village setting. However, usual practice data, needed for comparison studies, is completely absent from the published literature (Morrone, 2008; Ryan, 2006; WHO, 2005, p. vi). The results of this pilot study, combined with additional descriptive studies based upon this template, can be used to design comparison trials of proposed and

current usual wound management practices. When efficacious, safe, affordable, and available wound management strategies are identified, much-needed evidence-based protocols for wound management can be incorporated into these programs.

CHAPTER 2: LITERATURE REVIEW

This chapter presents the relevant scientific literature with regard to wound management in tropical developing countries. To provide the reader with context, the chapter first summarizes the published research from all developing countries (including those which are not in the tropics) on affordable wound treatments and dressings. Then, the chapter evaluates the published literature describing wound care practices in rural areas of tropical developing countries in detail. The need for a study describing what nonprofessional health providers in villages are currently doing to manage wounds is evident from the sparse literature on this topic. The rationale for this research study is further supported by a discussion of the recent recognition of the wound problem by the WHO (Macdonald, 2009). Specific future research studies building upon this one are proposed, and the chapter concludes with a brief summary.

Review of the Research Literature

Context: Affordable Wound Treatments and Dressings

An exhaustive search of the literature for evidence supporting affordable moist wound dressings and other wound treatments congruent with modern wound management principles for use in developing countries revealed only fifteen research studies, all describing work by medical doctors based in urban hospitals (Benskin, 2011). Although none of the studies included nonprofessional health care providers, and none took place in a rural environment, the results of this literature search are summarized here to provide context. The complete manuscript of this critical review of the literature is available by request.

Affordable wound dressing studies. Keswani and colleagues (1990) examined histology, bacteriology, and clinical outcomes in burns covered with a secondary dressing of either boiled potato peel (BPP) or gauze. This study included 17 patients with burns or scalds distributed over their bodies evenly enough for them to serve as their own controls (Keswani et al., 1990). Half of the burned area on each study patient was then covered with BPP dressings; a clinically equivalent other half was covered with gauze dressings (Keswani et al., 1990). Because wound infections were ubiquitous in this burn unit, silver sulphadiazine cream was applied to all burned areas on all patients (Keswani et al., 1990).

The BPP dressings led to faster healing, with a strong scar (Keswani et al., 1990). The wound areas dressed with BPP did not become macerated or dehydrated, and none of these wounds required grafting (Keswani et al., 1990). Patients were more comfortable with the BPP dressings than with gauze dressings (Keswani et al., 1990). Using patients as their own controls effectively eliminated many of the confounding variables inherent in wound research. Limitations of this study were the small sample size, lack of blinding or randomization, and that anaerobes were not cultured. Also, the use of silver sulphadiazine, which is not widely available in developing countries, avoids questions of a possible increase in infection risk with BPP dressings.

Dattatreya and colleagues (1991), inspired by Keswani and Patil's work, searched for the optimal BPP dressing by comparing dressings made from three varieties of potatoes using several different techniques on full thickness wounds

in 6 groups of 5 to ten rats each. This study confirmed that potato peels are semipermeable membranes suitable for dressing wounds (Dattatreya et al., 1991). However, the scientists found that BPP dressings are time-consuming and complicated to prepare (Dattatreya et al., 1991).

Another group of investigators chose a mixed methods format to compare BPP dressings to gauze in erosive wounds in eleven patients with a total of 25 wounds (Patange et al., 1996). Wounds were cleaned, and then a BPP dressing with a thin layer of antiseptic cream, and in the cases of pemphigus, steroid cream, was applied (Patange et al., 1996).

Patients found the BPP dressings to be comfortable and cooling (Patange et al., 1996). None of the patients developed secondary wound infections, and none of the wounds deteriorated (Patange et al., 1996). One patient with toxic epidermal necrolysis passed away (Patange et al., 1996). Of the remaining 24 wounds, 20 closed in 28 days, including difficult-to-heal wound types (Patange et al., 1996). In contrast to the findings of Dattatreya et al. (1991), Patange et al. (1996) found that BPP dressings were cost effective and easy to prepare. Patange et al. (1996) also found that BPP dressings were nonadherent – an important attribute of an ideal wound dressing heretofore not discussed.

The study by Patange et al. (1996) showed that BPP dressings can be efficacious in a clinical setting with a diverse patient population. However, aside from two patients with symmetrical wound sites, there were no controls. And, the use of antibiotic cream on every wound, like the use of silver sulphadiazine, avoids questions of a possible increase in infection risk with BPP.

Honey has been used on wounds for many centuries (Shukrimi et al., 2008). Honey's high osmolarity prevents bacterial growth, decreases maceration, and encourages healing (Moore et al. 2001; Tovey, 2000). Honey also continuously generates low levels of hydrogen peroxide, which inhibits bacterial growth without harming human tissue (Tovey, 2000). All honey is not equally efficacious: The composition of honey is influenced by the species of bee and the plant origin of the nectar, as well as processing and storage procedures (Moore et al., 2001; Tovey, 2000).

Subrahmanyam (1996) compared honey dressings to BPP dressings in a prospective randomized controlled trial of 100 patients with partial thickness burns (Subrahmanyam, 1996). While pain relief was the same in both groups, healing occurred significantly more slowly in the BPP dressing group (Subrahmanyam, 1996). The authors reported that the high osmolarity of the honey caused rapid absorption of edema fluid, which would explain the quicker healing (Subrahmanyam, 1996). Subrahmanyam used highly viscous honey, which acts as a physical barrier to prevent bacterial contamination of the wounds, produces hydrogen peroxide, and dehydrates bacteria (Subrahmanyam, 1996).

Moore et al. (2001) conducted a systematic review of human randomized controlled trials involving honey wound dressings. The reviewers found a high probability that honey is superior to all of the comparison treatments: polyurethane film, amniotic membrane, BPP dressings, and silver sulphadiazine (Moore et al., 2001). However, they reported that none of the studies were blinded, and only one study designated a primary outcome (Moore et al., 2001).

None of the studies included chronic wounds, and six of the seven studies were conducted by the same researcher (Moore et al., 2001). Moore et al. (2001) called for more research in resource-limited areas, where cost and availability are critical issues in wound care.

Recently De Buck and Van de Velde (2010), from the Belgian Red Cross, examined the published evidence for using BPP dressings rather than gauze alone for the acute management of burns. The researchers concluded that BPP serves to decrease wound desiccation, which can speed healing, but BPP dressings do not have significant anti-microbial properties (De Buck & Van de Velde, 2010). Banana leaves were as effective as BPP dressings (De Buck & Van de Velde, 2010).

The study De Buck and Van de Velde reviewed was carried out by Gore and Akolekar (2003) on 30 patients who had sustained partial-thickness burn wounds of up to 50% body surface area which could be divided into two equal parts (usually contralateral limbs), so that the patients could serve as their own controls. Because petrolatum gauze is not completely non-adherent, it led to traumatic dressing changes, and was replaced by non-adherent BPP dressings as the standard burn treatment (Gore & Akolekar, 2003). However, the facility also found preparation of BPP dressings to be time-consuming and difficult to teach (Gore & Akolekar, 2003). Gore and Akolekar (2003) found that banana leaf dressings are easier to prepare than BPP dressings. Although they are not semipermeable, banana leaf dressings were equal or superior to BPP dressings in every parameter tested, which included: pain, ease of handling, comfort, date

of epithelialisation or eschar formation, the need for grafts, and microbiological studies (Gore & Akolekar, 2003). Gore and Akolekar (2003) found that banana leaf dressings cost one-tenth as much as BPP dressings to prepare.

The study by Gore and Akolekar (2003) was well designed: Patients were their own controls, and outcome measures were practical. Limitations include: no blinding of clinicians or patients, the side on which the banana leaf dressing was used was not randomized, and all wounds were treated with povidone iodine ointment, obscuring any differences in the dressings' ability to ward off infection. Povidone iodine is also not always available in the developing world. The facility adopted banana leaf dressings as their standard for burns, using them to successfully treat over 2000 burn patients (Gore & Akolekar, 2003).

Sopata and colleagues (2002) compared relatively inexpensive plain polyurethane foam dressings to hydrogel dressings in a randomized controlled trial of 34 advanced cancer patients with 38 stage II and III pressure ulcers in Poland. The focus of the study was on how bacteria affect occlusive wound healing (Sopata et al., 2002). Efficacy was not statistically different between the two dressings (Sopata et al., 2002). Bacteria under the dressings varied over the course of the first three weeks for both dressings, but did not significantly affect healing rates or result in signs of infection (Sopata et al., 2002). The researchers concluded that occlusive dressings are safe and effective for the treatment of pressure ulcers, even in cancer patients (Sopata et al., 2002). A strength of this study is that anaerobic bacteria, as well as aerobic bacteria, were cultured. Limitations of the study are the small sample size, lack of blinding, and the lack

of a description of how bacteriological samples were taken. Sopata et al. (2002) found that high bacteria counts (some far greater than 10^6 cells/ml) did not impede wound healing. This finding suggests that despite the lack of topical antimicrobials in rural areas of tropical developing countries, utilizing moist wound dressings may be safe.

Medical-grade foam dressings are relatively inexpensive modern wound dressings, but even these dressings are cost-prohibitive for many patients in resource-limited environments (Varma et al., 2006). Varma et al. (2006) sterilized industrial-grade polyurethane foam (upholstery foam) and cut it into dressings, testing the foam in a randomized controlled trial in 48 diabetic patients with debrided lower limb wounds. The foam was soaked in saline, wrung out, placed directly on the wounds of 24 patients, covered with gauze pads, and wrapped with an elastocrepe bandage (Varma et al., 2006). The remaining patients received standard modern topical wound treatments such as desloughing agents or hydrogels (Varma et al., 2006). Patients in both groups were prevented from bearing weight on the wound area (Varma et al., 2006).

The foam was found to be relatively nonadherent and very absorbent, and wound healing occurred in significantly fewer days in the foam dressing group (Varma et al., 2006). All of the foam dressing group patients' wounds closed, while seven of the 24 patients in the standard care group had incomplete wound healing (Varma et al., 2006).

Some patients from both groups underwent skin grafts when their wounds were fully granulating (Varma et al., 2006), which may have biased the time-to-

closure results. Another potential source of bias was that 15 of the 24 standard care patients suffered from neuropathy, compared with only 6 of the 24 upholstery foam treated patients. Comparing the novel treatment (upholstery foam) to modern wound management, rather than to dry gauze, greatly contributed to the strength of the findings in this study. The investigators refrained from using antimicrobial topical agents under the upholstery foam (Varma et al., 2006). However, they did autoclave the foam (Varma et al., 2006), a process which is not replicable in many resource-limited environments.

Affordable wound treatment studies. Papaya pulp is a readily available and inexpensive traditional wound treatment in the tropics (Starley et al., 1999). Papaya contains proteolytic enzymes commercially used in meat tenderizer and enzymatic wound debriders (Starley et al., 1999). Starley et al. (1999) conducted a qualitative study on the use of papaya on pediatric burn patients in The Gambia, finding that infected or full thickness burn wounds gradually became clean enough for grafting when papaya paste was applied. Patient comfort in the warm environment of the ward was enhanced, because bulky or circumferential dressings were not needed: gauze secondary dressings adhered to the paste (Starley et al., 1999). The adherent dressings were soaked off with water (Starley et al., 1999).

The researchers caution that papaya paste should not be used in partial-thickness wounds because they may be converted to full thickness wounds by the papaya (Starley et al., 1999). This descriptive study provided useful pros and cons about a popular traditional wound treatment.

EUSOL (Edinburgh University Solution of Lime) has been used to kill wound bacteria and remove slough for decades, but it also damages granulation tissue, slowing healing (Bajaj et al., 2009). Bajaj et al. (2009) pointed out that while honey has been shown to be superior to EUSOL, sugar is far cheaper and more readily available than honey. Bajaj et al. (2009) compared sugar dressings to EUSOL in a randomized controlled trial of 50 traumatic limb wound patients. EUSOL significantly outperformed sugar on all reported indicators (Bajaj et al., 2009).

Limitations of this study include: Many of the patients had compound fractures, and the sugar was not distributed evenly on the wound (Bajaj et al., 2009). Initial wound size, which could have been a significant confound, is missing from the report.

While topical negative pressure is popular for controlling wound exudate and speeding wound contracture, commercial devices are cost-prohibitive for patients in resource-limited environments (Mody et al., 2008). Mody et al. (2008) compared a topical negative pressure device utilizing wall suction and a locally-constructed electronic controller to wet-to-dry gauze dressings in a randomized controlled trial of 48 inpatients with major wounds. While no differences were found between the two groups overall, pressure ulcers closed significantly faster with the topical negative pressure device, and topical negative pressure was less expensive than wet-to-dry gauze (Mody et al., 2008).

Strengths of this study include the use of a digital method of assessing wound closure, which increased objectivity, and the prospective randomized

controlled trial design. This study had several limitations. Patients reported that topical negative pressure was painful, but pain was not assessed (Mody et al., 2008). Of the original 55 patients, 19 dropped out of the study early, and only the pressure ulcer patients continued topical negative pressure to wound closure (Mody et al., 2008). The surgeons, who performed serial debridement on all patients, were not blinded (Mody et al., 2008). The cost evaluation did not include hospitalization (Mody et al., 2008). Wet-to-dry gauze, which is incongruent with modern wound management principles, was the comparison dressing (Ovington, 2002a). The topical negative pressure device relies upon both wall suction and electricity, which are available only in limited areas of developing countries.

Acute anal fissures develop as a result of constipation. Resultant ischemic ulcers can become chronic because the pain causes muscle spasms, which perpetuates the ischemia (Chintamani et al., 2009). A randomized controlled trial of 100 patients with this wound type compared the addition of once-daily application of an icicle made by freezing a water-filled surgical glove with the fingers tied off to the usual educational program, local anesthetic creams, laxatives and sitz baths alone (Chintamani et al., 2009). The icicle inserted partway into the anus acted as cryotherapy, lasting a mean of seven minutes before melting and being expelled, and most patients were able to prepare and insert the device at home (Chintamani et al., 2009). Pain scores, bleeding episodes, and fissure healing at two weeks, and, at three months, were significantly better in the group using the frozen glove finger treatment (Chintamani et al., 2009).

The treatment was believed to have promoted healing by breaking the pain-spasm-ischemia cycle (Chintamani et al., 2009). This simple study was well designed and showed that home cryotherapy is useful (Chintamani et al., 2009). Solar, gas-powered or electric freezers are sometimes available in resource-limited areas.

Wound debridement is a problem in resource-limited environments, where surgeons and commercial debriding agents are scarce. Moist dressings facilitate the natural breakdown of slough and wound debris by the body's own enzymes and white blood cells, a process called autolytic debridement (König et al., 2005). Martin and colleagues (1996) conducted a double-blinded randomized controlled trial comparing common lubricating (KY) jelly with an identical-appearing enzymatic debridement ointment (Varidase) on 21 stage IV pressure ulcers with black eschar in order to determine the efficacy of autolytic debridement. After the ointment was applied, all wounds were covered with a thin film dressing (Martin et al., 2006). Patients in the two groups were similar in ages, duration of wound, and co-existent illness (Martin et al., 2006).

Although eschar removal was faster in wounds treated with lubricating jelly than in wounds treated with enzymatic debrider, the differences were not statistically significant (Martin et al., 2006). This elegant study had the limitation of a very small sample size (Martin et al., 2006).

Summary of affordable wound dressings and treatments. In summary, the studies of affordable wound dressings showed that BPP dressings are superior to gauze, and that banana leaves are superior to BPPs. Polyurethane

and saline-soaked furniture foam were also effective moist wound dressings. Topical negative pressure can be achieved with ordinary wall suction. Ice can be a useful tool in wound healing. Honey, papaya pulp, EUSOL, and lubricating jelly proved to be efficacious affordable substances for treating and debriding wounds. Many of these treatments rely at least partially upon autolytic debridement. Papaya pulp can be unsafe if it is not very closely monitored. None of these studies directly address the research problem, because all of the wound management was performed by professional health providers in urban hospitals.

Literature on Usual Wound Management in Villages

A completely unrestricted PubMed search on 7 November 2012 for articles including current usual wound management practices in rural areas using (treat* OR manage*) AND (developing countries [MeSH Terms] OR Africa OR India) AND ((wound* AND skin) OR pyoderma OR (ulcer* AND skin) OR pustule* OR (sore* AND skin) OR (lesion* AND skin)) AND (rural OR village* OR remote) yielded only 92 hits. Every article was obtained and combed for any mention of topical wound management in rural areas of tropical developing countries. Most of the articles did not include any content related to the topic. The search was rerun without (treat* OR manage*) on 13 November 2012, yielding 244 articles. All articles not previously retrieved were read, with the exception of articles specific to diseases that cause superficial rashes, rather than wounds extending beyond the epidermis at least into the dermal layer of the visible skin. A CINAHL search on 26 Nov 2012 using the parameters from the 7 November 2012 PubMed search with “not in PubMed” as the only limit yielded 225 books, articles,

poster presentations, etc. All identified publications which might contain pertinent information were obtained and scanned for additional references, which were also obtained and read.

No articles with detailed descriptions of wound management practices in villages were found. However, the search process did yield three survey reports with brief descriptions of some aspect of usual wound management in villages, four ethnobotanical articles with tables including wound treatments, and four research studies on wound care interventions in rural areas of tropical developing countries. Authors did not identify any participants as VHWs, THPs, or VSCs.

Brief descriptions in survey reports. A 1993 epidemiological study of burns in Ethiopia included a survey of burn knowledge among villagers (Courtright et al.). Although the purpose of the study was to identify the causes and possible ways to prevent burns in the village setting, details about first aid for blistering or more severe burns larger than a chicken egg were included by the researchers (Courtright et al., 1993). Although villager first aid always included applying some substance to the burned area, only 30% of the 163 villagers surveyed would apply cold water (23%) or a clean cloth (7%), which are the only first aid treatments the authors recommended (Courtright et al., 1993). Butter or oil (47%), egg yolk (39%), or milk (5%) were the least harmful substances the villagers applied (Courtright et al., 1993). Courtright et al. (1993) acknowledged that egg yolk might be slightly helpful. Courtright et al. (1993) reported that 15.9% of the respondents, mostly older males, stated they would apply a clearly deleterious substance to the burn wound, including: dirt (7%) cow dung (4%),

unspecified traditional compounds (4%), or salt (2%). Among patients taken to the hospital (after an average of 7 days delay), 32% had undeniably been subjected to detrimental traditional topical treatments (Courtright et al., 1993). This study was limited to a brief description of first aid, without details about further wound management. However, it did provide a list of substances used on burns.

Arikpo and colleagues (2010) included several similar lists of treatments used by villagers on wounds in their study of self-medication in rural Nigeria. Arikpo et al. (2010) state that, “herbs, antibiotics, ash, kerosene, petrol, etc.” were used to treat any of 16 health problems, including four types of wounds, with no specific drugs used for specific ailments (paragraph 1). Folk remedies described were, “a mixture of traditional substances such as herbs, lime, honey palm kernel oil, etc., and modern industrial products such as medicated ointment, alum, antibiotics, etc.” (Arikpo et al., 2010, paragraph 14). Despite a low literacy rate in the study area, the reported response rate on the structured written questionnaire for randomly selected participants was 75%, for a total of 552 responses (Arikpo et al., 2010).

The only available choices for treatment habits on the survey were “doctor” or “self-medication” (Arikpo et al., 2010). Almost all (99%) of the respondents answered “self-medication” for all 16 ailments (Arikpo et al., 2010). The researchers reported that 10% used ointments to treat sore throat, while 0.0% used ointments for wounds and cuts (Arikpo et al., 2010). The questionnaire was not published. While it is likely that the example remedies are

used to treat health problems in this setting, the results suggest that the structured written questionnaire may have been a poor study design choice.

Landier et al.'s (2011) Buruli Ulcer prevention study in Cameroon also discusses a few specific wound management techniques in tropical villages. This survey relied upon verbal interviews to evaluate participants' activities and health habits, including their methods of wound first aid (Landier et al., 2011). Landier et al. (2011) found that use of alcohol or soap to cleanse wounds decreased the odds of developing Buruli Ulcer, doing nothing for the wounds increased the odds of developing Buruli Ulcer, and initial cleansing with leaf sap, ground tablets purchased in the market, or ointment was neutral. Applying a cloth or adhesive bandage was protective only if the bandage was changed at least weekly, while leaving the wound open to air was associated with an increased risk of developing Buruli Ulcer (Landier et al., 2011). The interviewers used a closed-ended questionnaire; washing with plain water or salt water was not listed among the responses (Landier et al., 2011). The study focused upon the use of bednets and occupational activities, and it did not discuss usual wound management practices of villagers, but it did support the idea that VSC can influence wound outcomes (Landier et al., 2011).

These three studies are useful in that they provide lists of possible choices for usual wound management in rural areas of tropical developing countries. However, they do not give detailed descriptions, and each focuses on only one small geographical area.

Ethnobotanical articles. Although THPs are sometimes reluctant to share their knowledge of medicinal plants (Jagtap et al., 2006; Vandebroek et al., 2004), many published papers by ethnopharmacologists have cataloged plants used by THPs and VSCs in various rural areas of developing countries. No published studies that evaluated the efficacy of any wound treatment performed by THPs were found. Only four studies were found describing how plants and other local materials are used by villagers to treat wounds (Agyare et al., 2009; Bussman et al., 2011; Jagtap et al., 2006; Pratap et al., 2009). These four studies all provide tables listing plant names, parts used, method of preparation (poultice, powder, or decoction), and ailment(s) (including wound type, when applicable) for which each plant is indicated (Agyare et al., 2009; Bussman et al., 2011; Jagtap et al., 2006; Pratap et al., 2009). However, none of the studies included wound bed preparation, wound coverings, or any details of wound treatment.

Intervention studies. The largest of the four wound intervention studies was a five year long dermatology project reported on by Schmeller in 1998 and by Schmeller and Dzikus in 2001. VHWs in rural western Kenya were taught to identify and treat common skin diseases in ~5000 children from 13 schools (Schmeller & Dzikus, 2001). Gentian violet paint (1%) was used on bacterial skin infections, wounds and tropical ulcers (Schmeller & Dzikus, 2001).

When 1999 skin disease rates were compared to 1993 pre-intervention statistics, Schmeller and Dzikus found no significant reduction in numbers of dermatitis, scabies, or bacterial infections, and a significant increase in fungal

infections (2001). Schmeller and Dzikus (2001) did report a distinct reduction in the extent and severity of skin diseases in 1999 when compared to 1993, but this was not quantified. They also reported a ten-fold decrease in tropical ulcers, alongside an increase in impetigo (Schmeller & Dzikus, 2001). The researchers concluded that the expensive school project yielded few long-term benefits to the community (Schmeller & Dzikus, 2001).

Gentian violet paint is an antiseptic (Ryan, 1992). Therefore, modern wound management principles would justify its use on superficial skin diseases, but not on deep wounds such as ulcers (Macdonald & Asiedu, 2010; Ryan, 1992). Although gentian violet paint would quickly be diluted by wound exudate in a tropical ulcer – Robinson et al. (1988) report that tropical ulcers are often up to 2 cm deep – it is possible the treatment prevented some cases of impetigo from developing into deep lesions (Ryan, 1992).

Desai and colleagues (1985) reported on a one-day intervention carried out in a rural area of India to decrease the incidence of scabies, pediculosis, ringworm, and pyoderma. Twenty-five VHWs diagnosed 1787 patients out of a population of 17019; the team then treated pyoderma with oral antibiotics and topical gentian violet paint (Desai et al., 1985). Scabies and pediculosis were treated directly by the VHWs with lindane (Desai et al., 1985). The researchers concluded that this was an effective method for decreasing the incidence of scabies and pyoderma in epidemic situations, but the intervention was too cost-prohibitive for routine control of these diseases (Desai et al., 1985).

Pyoderma prevalence rates as high as 70% in the remote Australian Aboriginal population were associated with an alarming rate of chronic renal failure due to glomerulonephritis (Lehmann et al., 2003). Following the opening of a swimming pool in an Aboriginal community in the Northern Territory, a reduction in skin infections was reported (Lehmann et al., 2003). Swimming pools were built in two remote Aboriginal communities in Western Australia in hopes that their use among schoolchildren would decrease the prevalence of pyoderma and otitis media (Lehmann et al., 2003). After two years of the swimming pool intervention, pediatric pyoderma rates in the two communities had fallen from 70% and 62% to 20% and 18%, and severity of pyoderma cases declined as well (Lehmann et al., 2003). However, funds were not available to expand this intervention to other communities (Lehmann et al., 2003).

When researchers studying guinea worm disease in Ghana found that only 0.5% of the sufferers had gone to clinics for their wounds, they taught some of the villagers to perform self-care (Belcher et al., 1975). The 69 patients who were given antibiotics and instructions for cleaning, soaking, and dressing wounds by the researchers were disabled for an average of 2.4 weeks, as compared to disability for 5.3 weeks among the controls (Belcher et al., 1975).

None of these four intervention studies discuss usual wound management practices utilized prior to their intervention, and none of the interventions were sustainable long-term. More affordable solutions are needed to solve the wound problem in rural areas of tropical developing countries.

Rationale for This Research Study

Need for Evidence

The World Health Organization (WHO) has partnered with the newly-formed World Alliance of Wound and Lymphoedema Care (WAWLC) to respond to the problem of poor wound management in developing countries with programs teaching modern wound management methods (MacDonald, 2009; Macdonald & Geyer, 2010). However, formal tests of these modern wound management methods were performed in temperate climates by highly educated practitioners (Macdonald & Geyer, 2010, p. 2). These methods may not uniformly generalize to the hot climates with extremes in humidity found in resource-limited rural areas of tropical developing countries, where health professionals are absent.

The Principal Investigator (PI) and other wound experts have experienced unfavorable results when translating many modern wound management interventions into harsh tropical environments. When wounds are managed by THPs, VHWs, or VSCs, rather than by health professionals, other limitations may emerge.

Some indigenous wound management practices may out-perform some methods used in countries with more resources. For example, covering wounds with banana leaves keeps wounds moist (meeting modern wound management criteria), allowing them to heal quickly, while petrolatum gauze dressings, commonly used in developing countries, inhibit healing by allowing wounds to dry (Bolton, 2010; Gore & Akolekar, 2003). Therefore, along with introduced

affordable innovations, beneficial wound management practices currently employed by a few isolated villagers should be disseminated to others.

Prior to launching an educational program, proposed protocols based upon modern wound management principles should be tested against the current practices of the indigenous people in real-world settings to establish ecological validity (Gliner et al., 2009, p. 129). However, heretofore, current usual wound management practices of THPs, VHWs, and VSCs in rural areas of developing countries had not been delineated. Before a comparison study could be designed, current usual topical wound management practices of THPs, VHWs, and VSCs had to be identified.

Addressing the Gap

Experts agree that wounds have been ignored in the published literature about health care in developing countries, even within the WHO (Morrone, 2008; Ryan, 2008; WHO, 2005). This study is a first step towards addressing this gap in the literature. The study characterizes the usual wound management practices of VHWs, THPs, and VSCs who manage wounds throughout a variety of ecosystems in rural areas of a developing country: Ghana, West Africa. The study's unique design template can easily be adapted to the cultures of other tropical developing countries.

The data from this and similar studies in other areas of the globe can be utilized to develop experimental studies comparing the identified usual practices of indigenous wound care providers and proposed affordable introduced interventions based upon modern wound management principles in the rural

tropical setting. Such comparative studies can reveal which topical wound management practices are safe and effective in rural areas of tropical developing countries, establishing ecological validity (Gliner et al., 2009, p. 129).

Developers of wound care teaching programs will then have confidence that they are including protocols which the evidence supports as being safe and efficacious in the very challenging setting of the rural tropical village. Ineffective or harmful current usual topical wound management practices discovered in this study can be more successfully replaced by introducing safer and more efficacious practices in culturally acceptable terms, emphasizing superficial similarities between the familiar and the innovation.

Future Directions

The PI is a Certified Wound Care Nurse, Certified Wound Specialist nurse educator with experience providing health care and teaching VHWs and VSCs on short-term medical trips and while living for five years in a remote area of Ghana, West Africa. The PI's long-term research and educational goals are to improve the health of villagers by validating safe, effective, sustainable health promotion, illness prevention and treatment protocols, including wound management protocols, and then teaching this information to indigenous nonprofessional health providers. Although much of the educational material is useful world-wide, the PI has chosen to focus upon the needs of the 36 lowest-income tropical countries (Figure 1). Information from the World Bank 2011 and CIA World Fact Book 2012 affirms that these 36 countries have a combined rural population of over 578,000,000 (Appendix B) (Alkire & Santos, 2010; Central Intelligence

Agency, 2012; United Nations Development Programme, 2011, p.129-130; World Bank, 2011).

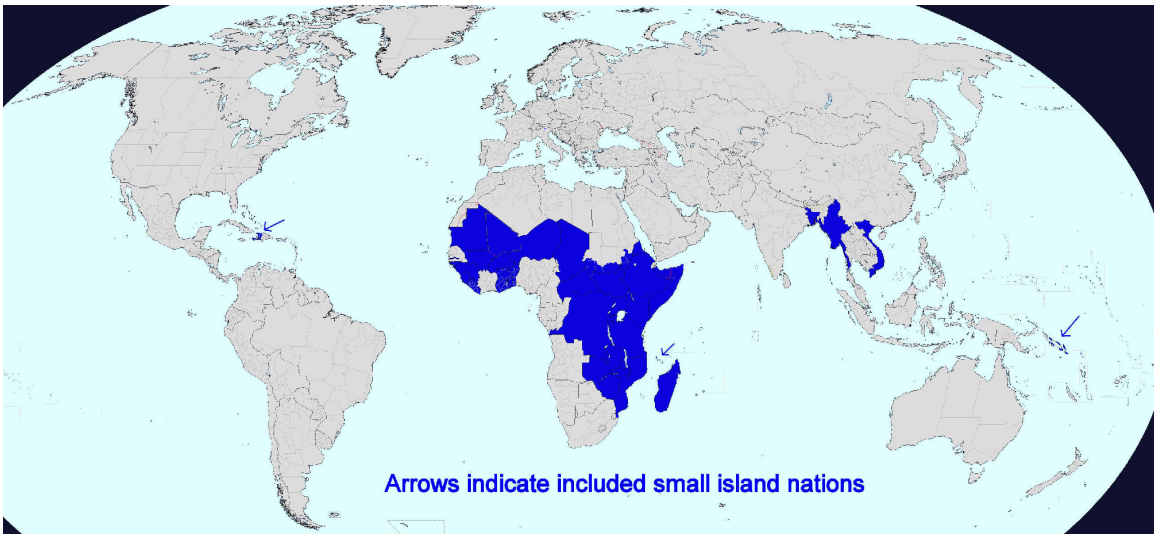


FIGURE 1: THE 36 LOWEST-INCOME TROPICAL DEVELOPING COUNTRIES
(map adapted from public domain world map by Smurfy)

Summary

This pilot study begins to establish a baseline for future comparison studies to identify sustainable wound management practices that prove safe and effective in this challenging real-world setting. This is an essential step towards the development of much needed culturally and environmentally appropriate wound management protocols for indigenous wound care providers in rural areas of tropical developing countries (Ryan, 2006).

CHAPTER 3: RESEARCH DESIGN AND METHODS

This chapter begins with a discussion of the study design. Modern wound management principles are defined, and the scope of this pilot study is articulated. The system chosen for organizing the responses is explained. The research team is introduced, and the selection of study participants is described. Because this study uses an innovative data collection design, the purpose and details of the study design are explained. Since this pilot study may be replicated in similar environments in other tropical developing countries, the data collection procedure is described at length, including some of the obstacles that had to be overcome by the research team. Finally, the data analysis procedure is presented. One purpose of this chapter is to provide a detailed template for future researchers to adapt when designing similar studies in the challenging setting of rural areas of tropical developing countries.

Foundation

Study Design

The PI chose a comparative approach to achieve the aim of characterizing usual topical wound management practices in rural areas of Ghana because this study design can produce concrete, actionable results and is compatible with a topic about which so little is known. In this approach, "the independent variable has two to four levels such that two to four groups are compared" (Gliner et al., 2009, p. 46). For this study, the comparative approach was used to address four research questions: (1) What are the *defining characteristics* of the topical wound management practices of THPs, VHWs, and VSCs in rural areas of Ghana? (2)

What are the similarities and differences between topical wound management *subcategories* performed by each of these three provider groups across the seven different wound types? (3) What are the similarities and differences between topical wound management *domain* practices performed by each of these groups across seven different wound types? (4) Are there differences in provider practice with respect to *wound type*? The case studies selected as exemplars include seven wound types which are commonly encountered in tropical villages in developing countries (Appendix C). For the purposes of this study, a village is a community of people whose resources are limited by their relative lack of access to modern infrastructure.

Modern Wound Management Principles

Rather than positing a hypothesis to be tested, research questions were posed, as is usual in a descriptive study. However, the data organization and analysis was guided by modern wound management principles as explicated by Bolton (2007) and Macdonald and Asiedu (2010). Modern wound management principles are based upon research by Winter (1962) and others, which has shown that wounds in temperate climates heal more quickly and with fewer complications if the wound bed is: thoroughly cleansed to remove chronic wound fluid and debris, debrided of necrotic tissue and non-healing edges, protected from contact with cytotoxic substances and external trauma, kept moist enough to permit the new cells to migrate easily across the wound bed without causing maceration of the wound edges, and protected from unchecked inflammation and edema (e.g., Laforet et al., 2011; Macdonald & Geyer, 2010; Sibbald et al., 2011).

Bolton's (2007) description of moist wound healing includes: alleviating the cause of the wound, assessment, cleansing, alleviating pain, debridement, and applying moisture-balancing dressings. Macdonald and Asiedu (2010) list five basic principles of modern wound management for work in developing countries: assessment, avoidance of trauma to the wound, debridement and infection control (which would include cleansing), moisture control, and control of edema/lymphedema. Although these wound experts differ in their perspectives and emphases, the standards are consistent with one another with respect to the *topical* aspects of wound management.

Scope of the Study

Although controlling wound pain directly impacts wound healing (Benskin, 2012b; White, 2009), differing cultures address pain in very different ways. Wound assessment parameters are often intuitive (Maylor, 2003), making them particularly difficult to communicate cross-culturally. Therefore, although data concerning wound pain management and initial wound assessment were recorded when they were provided, the aim and research questions addressed by this pilot study were limited to the usual *topical* wound management practices in rural areas of Ghana, West Africa. The definition of *wound* for the purpose of this study is a physical break in the skin. The wounds included in this research extended beyond the epidermis at least into the dermal layer of the visible skin.

Given the challenges of traveling to villages in various areas of Ghana, it was expected that it would rarely be possible to visit more than one village in a day. Some villages would have to be visited more than once because of

miscommunications resulting in key participants being away from the village on the day the research team arrived. Rains which flood roadways and make muddy paths impassible are not entirely predictable in this area of the world. There was concern that some villages might refuse to participate in the study. The PI had limited time and funding for this dissertation study. For all of these reasons, a purposive convenience sample size of 25 villages, yielding a total of 75 participants (one VHW, one THP, and one VSC in each village) over a period of no more than 90 days, was deemed feasible for this one-country pilot study.

Organization of Responses (Data)

The PI summarized the topical aspects of modern moist wound management into three *domains* for the purposes of this study: *wound bed preparation* techniques (methods of cleansing and debridement), *wound treatments* (salves, powders, poultices, wraps, elevation, heat and cold, etc., used to decrease infection, balance moisture, and control edema/lymphedema and inflammation), and *wound dressings* (commercial or indigenous). The PI identified six practice *subcategories* for each of these domains (two under each domain): Cleansing (IA), Debridement (IB), Infection/Moisture Control measures (IIA), Inflammation/Edema Control measures (IIB), Commercial dressings (IIIA), and Indigenous dressings (IIIB). Each subcategory can include practices which do conform and practices which do not conform to modern wound management principles (see Table 1).

The response for each wound case for each participant, informed by the rationale given by the participants for their choices, was categorized by the PI as

congruent or not congruent with modern wound management principles based upon Bolton (2007) and Macdonald and Asiedu (2010) for both practice subcategories and the more global domains. The result was dichotomous dependent variables (congruent/yes=1, incongruent/no=0) for each domain and subcategory for each wound type case for all 75 participants.

TABLE 1: ORGANIZATION OF DATA (FOR EACH WOUND TYPE)		
	Congruent with modern wound principles?	
	Yes	No
I. Wound Bed Preparation		
A. Cleansing		
B. Debridement		
II. Wound Treatments		
A. Infection/Moisture Control		
B. Inflammation/Edema Control		
III. Wound Dressings		
A. Commercial Materials		
B. Indigenous Materials		

The independent variable in this study is the wound care provider: VHW (village health worker, representing scientifically verified medicine), THP (traditional health practitioner, representing traditional medicine), or VSC (villager who provides wound self-care, representing self-care). The dependent variables are the specific wound management choices and the summaries at the domain and subcategory levels, measured at the nominal level (yes/no), and indices that reflect summary measures at the interval level for a) each of the practice subcategories and domains averaged *across* all seven wound types meeting the principles of topical modern wound management (WndSub and WndDom); and

b) for each of the practice subcategories and domains *within* each wound type (SubType and DomType).

Participants' congruent responses for each of the wound types for each subcategory were added together and divided by the total number of wounds for which they gave a response, so that the choice not to respond to a particular wound type (an unfamiliar wound type, or a type they would refer, rather than treat) would not skew the data. This resulted in overall mean scores of congruent responses for each participant for each of the identified six subcategories of modern wound management (WndSub). Similarly, overall mean scores of congruent responses for each participant for each of the identified three domains of modern wound management were calculated by adding together the participants' congruent responses for each of the wound types for each domain and dividing by the total responses they gave (WndDom). Because the data contained only blanks for wound types which a participant would not treat, SPSS could automatically omit participants who would not treat a wound type from the indices calculated within each wound type (rather than across all wound types). Therefore, indices within each wound type were calculated by simply adding together the participants' congruent responses for the subcategories (SubType) and the domains (DomType).

Prior to initial data collection, expected specific wound management choices were listed in outline form by domain and subcategory, distinguishing between techniques which are congruent with modern wound management principles and those which are not (Appendix A). In keeping with the research

proposal plan, additional dependent variables were identified as the data were categorized, and were entered into the outline and a spreadsheet with separate tabs for each wound type.

The Research Team

The Principal Investigator

The Research Team was led by the PI, a wound specialist nurse with extensive experience working in rural areas of tropical developing countries, including five years of managing wounds and teaching village health workers while living in a remote area of Ghana, West Africa. The PI was well prepared to perform nursing research by the PhD program at the University of Texas Medical Branch (UTMB). Although this was not an intervention study, the PI has Ghanaian credentials (SRN: State Registered Nurse), permitting her to diagnose illnesses, prescribe medications, and treat wounds in medically underserved areas of Ghana without supervision. These credentials grant credibility, which was needed in some situations. The PI also has experience holding mobile clinics in villages in Ghana and other developing countries, which contributes to her cultural literacy. The PI can greet in several of the local languages of Ghana and can converse freely in Ghanaian English.

The Research Assistant

The Research Assistant (RA) also has experience working in rural areas of tropical developing countries, including five years of maintaining a mission clinic/well drilling compound while living in a remote area of Ghana, West Africa. He is well versed in the cultural norms of meetings with tribal and village chiefs

and village elders, and has physical attributes which command respect in Ghanaian village cultures, including large stature, greying hair, and male gender. The RA is experienced at driving safely and keeping vehicles functional in the face of the unique challenges typically encountered on village roads and major highways throughout Africa. The RA is also especially skilled at improvising repairs and finding other innovative solutions to electronic equipment failures in resource-poor settings. These skills were frequently required, as the project and the environment placed heavy demands upon the aged 4WD pickup truck and the assorted portable electronic devices.

The Interpreters

Ghana is home to at least 79 tribal languages (Lewis, 2009). Participants in this study represented ~15 different major tribal groups. Ghanaians living in villages often speak only a unique dialect of their tribal language. Therefore, interpreters assisted with most of the interviews. The PI had worked with interpreters in clinics and Bible Colleges throughout Ghana, providing her with a pool of experienced interpreters who were each fluent in several of the many Ghanaian tribal dialects. Most of the interpreters chosen for this study were familiar with wound care terminology as a result of having had at least some VHW training. In order to minimize the likelihood that the interpreter was acquainted with a participant, interpreters were not recruited to interpret in villages in which they lived or worked unless an interpreter fluent in the local language could not be found outside the village.

The original study plan was to hire interpreters from the nearest of the two clinics in Ghana (located in Kumasi and Yendi) for most of the interviews, with preachers or VHWs acting as backups when villages were far from these two "base camps." However, before the PI and RA arrived in Ghana, preachers with text and email connectivity began asking to act as interpreters in their areas of Ghana. The PI expected this to be a source of supplemental income for the preachers, but most refused cash payments or even reimbursement for public transportation expenses, accepting only a study flashlight as a token gift of appreciation. They argued that the PI and RA were guests, and they were honored to be able to assist in their research study, which would clearly result in improved healthcare for their people.

This change in interpreter recruitment proved to be very beneficial, because the preachers generally utilized public transportation to rendezvous with the team at or en route to the target village. Picking up and dropping off one of the clinic interpreters could add as much as 4 hours to an already long work day. The clinics were each given a generous donation in appreciation of their support for the research study. Although they continued to receive their usual salaries, the clinic interpreters were provided meals and a small gift.

Additional Support

Ghanaian colleagues and friends were eager to assist with logistics for this study. Rental vehicles for travel across the country of Ghana are very difficult to obtain and expensive. Visitors usually either take public transport, or hire a car and driver, which leads to the additional expense of supplying the driver with food

and lodging and the decreased flexibility inherent in traveling with a stranger. The Yendi clinic generously loaned the study the vehicle the RA and PI drove when they lived in Ghana. While it was admittedly old and worn (lacking such amenities as functional air conditioning), having access to this familiar 4WD pickup was a tremendous blessing, significantly simplifying the logistics of the trip.

The PI anticipated that the Yendi clinic's guesthouse would be the team's primary base of operations. In fact, the clinic director upgraded the team to the house the PI and RA lived in during their five years in Ghana, which boasted hot showers when the sun was shining. However, current internet map sites were inaccurate in marking the road from the coast to Yendi as paved – portions are still unimproved, which rendered it impassable due to deep mud and rain-swollen rivers. This doubled the driving time (from ~6 hours to ~12) from the major cities in southern Ghana to Yendi. Also, despite reports to the contrary, neither of the two cell phone carriers for the study's mobile hotspots supplied a fast internet connection to the Yendi area. This made Yendi unattractive as a base camp.

Auspiciously, friends with a home near the capital and a village house opened them both, with cooking privileges, to the research team for a significant portion of the study. Both houses are on paved roads at the edge of major cities. The village house was located near the heaviest concentration of VHWs who had responded to the PI's letters. While the electricity was not always reliable at this location, aside from brief outages the mobile internet connection at the village house was the fastest the team experienced in all of Ghana.

Participants

The 75 participants in this pilot study were one THP, one VHW, and one VSC in each of 25 rural villages in Ghana, West Africa. Based upon the literature and the PI's personal experience, it was anticipated that almost all villages would have multiple THPs and VSCs (Ryan, 2006; Vandebroek et al., 2004). However, comparatively few villages in Ghana have a VHW. Only villages with active VHWs who were willing to participate were included in the study.

Sampling Method

The PI taught and/or supervised over 175 VHWs while living in Ghana from 1999 – 2004 and had retained their addresses. Letters of inquiry (Appendix D) about the status of these VHWs' participation in healthcare, with no mention of the study, were mailed from the USA to these VHWs four months in advance to identify villages which currently have VHWs who are providing wound care. Addresses in Ghana are postal boxes and often serve entire communities, such as schools, churches, and employers. Although not all of the VHWs were still in contact with the communities at the addresses, and some letters never arrived at their destination, some letters reached active VHWs. Through email, Facebook private messages, and texting, many of these VHWs provided the PI with current cell phone numbers (usually two numbers per individual) and vague directions to their respective villages. The VHWs contacted in this way provided the PI with cell phone numbers for other active VHWs whose letters were misdirected.

Inclusion

All VHWs who indicated that they were active in wound care in villages

were contacted by cell phone, informed about the research study, and invited to participate. Every active VHW who was contacted expressed an eagerness to participate in the study. Arrangements were made to visit this purposive convenience sample of the villages of the VHWs who were active in wound care at a time when village leaders and other participants were available.

Perhaps because none of the VHWs drive, their directions to their villages were often cryptic. The PI had paper road maps of Ghana from four different publishers, plus detailed Google maps downloaded onto an Android device. Each map included different villages, listed different names for the same villages, and showed different roads. Some of the roads shown on the internet-based map no longer existed. Often there were multiple villages with the same name in a given area. Through a combination of triangulating the data from the maps, consulting with the VHWs, and asking for directions from pedestrians and taxi drivers, the research team was able to locate every targeted village.

An effort was made to visit remote villages when they were most likely to be accessible, based upon frequently updated reports of rainfall patterns from the VHWs, preachers, and other Ghanaian colleagues. Through careful timing of travel routes, judicious use of four-wheel-drive, ability to hike short distances, and Providence, all of the targeted villages were physically accessible to the research team sometime during the data collection period (13 August - 21 October 2012).

Exclusion

During interviews with several of the VHWs it became evident that they practiced exclusively under the supervision of a health professional, rather than

making wound management decisions independently. Those interviews were not included in the study. In one village, during the interviews, the PI discovered that none of the THPs actually performed wound care: That village was omitted from the study per the study protocol. An unanticipated benefit of so few VHWs receiving the PI's letter of inquiry is that the potential for bias in the selection of participants was avoided. The only unvisited VHW still on the list of potential participants when the goal of gathering data from 25 villages was met had reportedly did not qualify for the study, because he provided health care only in a hospital setting and had no experience making wound management decisions independently.

Innovative Data Collection Design

Barriers to communication

Communicating cross-culturally can be quite challenging. Barriers to obtaining accurate survey data in this setting are formidable, and include: (1) cultural differences that prevent classical pencil and paper surveys from being understood, (2) a universal reluctance to expose one's work to others for evaluation, (3) a cultural predisposition towards providing pleasing answers in preference to accurate answers, and (4) the possibility of the survey focusing upon wound problems that are not commonly encountered in villages.

Case Story Concept

Ghana has a strong oral tradition, in which important transactions are always handled face-to-face, even among literate members of society. Data collection interviews with the THPs, VHWs, and VSCs consisted of culturally

appropriate conversations centering around the stories of seven de-identified wound patients, using actual photographs of wounds with each photograph representing a different wound type. Open-ended questions were asked to elicit a chronology of the usual wound management practices of each participant for each of the seven wound types.

International conferences for wound experts often include at least one panel discussion in which a moderator presents a series of wound case studies (e.g., Diegelmann et al., 2011, p. 11; Regan, 2011, p. 8). A photograph of a wound and a brief history allow the panel and the audience to gain an understanding of each case in turn. The moderator encourages the audience to consider how they would manage each wound case in the series. The group then discusses the options impromptu, as a mutual learning exercise. This exercise has a proven track record of eliciting a realistic individualized management plan for a diverse array of wounds from both the experts at the podium and the experienced wound care providers in the audience.

Barrier 1 was addressed by placing this case study methodology within a story framework to elicit wound care details from the study participants. Story-telling is integral to most cultures in developing countries, and has been used successfully to enhance communications about health issues in these settings (Silver, 2001). Photographs can also be used to enhance communication. Discussing disassociated case studies is less psychologically threatening than discussing ones' own behavior (Rollnick et al., 2007, p. 63). Using disassociated

case studies and emphasizing the anonymous nature of the data in the study design helped to address barrier 2.

Barrier 3 was addressed by asking only carefully worded open-ended questions (see Procedure, below) to elicit a detailed description of how the participant would usually manage each of the seven wound types. Asking only open-ended questions avoided inferring to the participant that any particular aspect of wound management, such as cleansing or debridement, was expected. Asking only open-ended questions also decreased the likelihood of interviewer bias creeping into the data. Graf et al. (2010) reported the successful use of open-ended survey questions to diminish problems with inferring answers to participants and to diminish surveyor bias in a study evaluating the effectiveness of a water quality intervention in improving the health of children in Cameroon.

Choosing Representative Wounds

Five Ghanaians collaborated with the PI in choosing the array of wound case studies for this research study to address barrier 4. Thirty actual wound cases (photos and brief patient histories) taken from the investigator's portfolio of wounds managed in a rural clinic in northern Ghana were presented, via email, to Ghanaians who are experienced in wound care and familiar with village life. The five Ghanaian experts each responded to twenty questions, which were carefully worded to help the PI determine which five of the wound cases were most representative of those commonly encountered in Ghanaian villages.

The emailed responses from the Ghanaian experts indicated that there are seven common wound types in Ghanaian villages, rather than five. The

anticipated five common wound types were abscesses, burns, leg ulcers in schoolchildren, chronic ulcers in adults, and trauma wounds. The Ghanaian experts asserted that osteomyelitis is also common, presumably because often bones are not set properly, resulting in malunions. They also added skin cancers to the list of representative wounds. Skin cancers may be common in villages because they tend to develop at chronic wound sites (squamous cell carcinoma) and in scars (Marjolin's Ulcer carcinoma), particularly from burns (Asuquo et al., 2007; Nthumba, 2010; Robinson et al., 1988; WHO, 2005, p. 20).

The seven wound cases the five experienced Ghanaians chose as interview prompts for this study are shown in Appendix C. These Ghanaian experts expressed confidence that the proposed culturally-sensitive method of obtaining data (using these seven representative case studies with a story-telling format) would yield meaningful results. Several of the Ghanaian experts also volunteered that participants in the study were likely to feel honored to be invited to share their knowledge, affirming that the study design was a sound one for overcoming barrier 2 (reluctance to expose one's work to others for evaluation).

Data Collection Procedure

Participant protections were provided in accordance with Western cultural standards, as explicated in the Belmont report and enforced by the University of Texas Medical Branch Institutional Review Board. Ghanaian cultural standards were also honored. The research team members dressed and behaved appropriately for the Ghanaian village setting. Respect for the village hierarchy demanded that permission to work in the village be obtained from the village

chief and/or elders. All data were collected face to face, respecting the oral tradition of the Ghanaians and avoiding distinguishing between literate and illiterate villagers.

Consents

It is usually necessary to obtain permission to work in a village on the day of the visit. When the villagers indicated that this was appropriate, the research team went to the village leaders (elders/chiefs) with *cola* (a bill of local currency worth ~$5 US, given to show deference). The RA (through the interpreter) asked the village leaders to give permission for the PI to interview individuals in the village who manage wounds, as is appropriate in this culture (Tindana, Kass, & Akweongo, 2006). Invariably permission was granted, but if it had not been, the village would have been omitted from the study, as per the study protocol.

Some of the chiefs remembered the PI from when she lived in Ghana. On two occasions a paramount chief (one of whom has authority over a tribe of 1,000,000 people) gave permission for the team to visit all of the villages in his realm. Out of respect, the research team also asked the local village leaders for permission to interview in their villages. In some villages, rather than the RA giving the village leaders cola, chiefs and/or participants showered the research team with gifts of agricultural products in an expression of hospitality and gratitude for the attention they were giving to the wound management problem.

After obtaining permission to interview participants in a given village, the RA asked the village leaders to identify the main individual in the village who managed wounds. Although the literature indicated that this would usually be a

THP (Ryan, 2006; Vandebroek, 2004), it was often the VHW. One of the village chiefs displayed his bandaged foot, which was being treated by the VHW. When the village leaders named the VHW, the RA asked who else managed wounds, as per the study protocol. The village leaders then identified a THP. The village elders/chiefs usually directed the research team to a THP and to the VHW in their village. In several instances, the village chief was the THP. Sometimes the identified THP lived in a nearby village, serving a larger population. The THP is often from another tribe – this seems to add to his mystique.

The social status of THPs often exceeds that of the chief of their village. Therefore, even after the PI gained permission to conduct interviews in a village, there was always a concern that the THP would decline to participate. Contrary to the expectations of the PI and the Ghanaians who provided advice on the study design, after the purpose of the study was explained, the THPs who managed wounds for members of the targeted villages all appeared honored to be invited to participate. However, while the THPs were quick to agree to answer some study questions, interpreters often had to cajole the THPs to keep them talking by repeating the purpose of the study, assuring them that the PI was not the competition. The PI assured the THPs that it was acceptable to tell only the general item they would use for a wound (a leaf, a root, etc.), even if they would not name the plant from which it came. All of the THPs gave answers that were detailed enough to permit the PI to code them on the spreadsheet.

Most, but not all, THPs and VHWs are male. In each village, in addition to the semi-structured interviews with a THP and the VHW, the PI also asked

permission of an adult villager (VSC) to discuss their wound self-care. Because village women tend to have little discretionary time, the PI made an extra effort to invite women when choosing willing villagers as VSC participants. The first willing villager who admitted to caring for wounds for themselves, their family, or neighbors was included in the study. Finding a VSC participant sometimes proved difficult. In some villages, virtually every individual clamored to be included in the study, but in other villages, villagers insisted that they all went to the VHW or nearest government clinic for all of their health care needs. Moving to the opposite side of the village and asking if there was a grandmother in the area who helped children with wounds usually yielded a willing VSC participant.

Potential participants were informed that the purpose of the study was to share with other health experts worldwide what villagers are doing to manage wounds, so that we could learn how to provide better wound care from the pooled information. The interview procedure, including the fact that the interview would be recorded, was explained in depth. The statement (an ethics requirement) in the consent request that refusal or halting the interview prior to completion would result in no untoward consequences (Appendix E) was usually met with laughter and statements like, “Of course.”

After agreeing to participate, villagers were asked permission to be interviewed, which they often found confusing. The Ghanaian culture is a face-to-face culture. In this setting, engaging in the discussion and answering the questions implies consent. However, for this study, explicit recorded verbal consents were obtained from all study participants, together with the interpreter’s

translation of each conversation. This interaction was recorded (verbal consent).

There are several rationales for the choice of verbal, rather than written, participant consent in this study. The cultures of villagers in developing countries are primarily oral rather than literate (Silver, 2001). Written consents for obtaining information and performing health interventions are rarely obtained in Ghana. Thumbprints in lieu of signatures are sometimes utilized in Ghana for formal legal transactions. However, if thumbprints on written consent forms had been required for this study, illiterate participants may have hesitated to participate due to concerns that the document may obligate them to something other than what the PI claimed.

Interview procedure

Interviews occasionally took place in participants' homes or places of business. More often, the participants, village leaders, or PI chose the site of the interviews based upon the location of deep shade, with seating being organic (tree roots) or portable (plastic chairs, wooden benches, or traditional low stools). When appropriate, the PI asked each participant if they would prefer to move to a more private location, or to dismiss any onlookers for the interview. None of the participants expressed any interest in privacy, as was expected given the high value the culture places on participation in community. In some instances participants insisted upon calling their friends and family to come witness the interview. One THP agreed to participate only on the condition that his name be included in the report. A photo of his membership card from the Traditional Medicine Practitioners Association was included in a PowerPoint presentation.

Although the PI texted and telephoned the VHWs in advance to make it very clear that the study design required her to interview only three individuals who met specific qualifications, villagers often insisted upon a large community gathering. Health education is usually provided to villagers in group settings (Tekola et al., 2009). The crowds sometimes posed a problem with hearing the participants' responses due to ambient noise and loud interjections. The PI had to repeatedly explain that this was the participants' story, and others could discuss their ideas at another time.

After describing the nature of the study and obtaining verbal consent (Appendix E), the PI presented the VHW, THP, or VSC with a wound photograph on a laminated card, verbally related the case history (introduced as "the beginning of the story"), and asked, "Have you seen a wound case like this one before, perhaps not as serious, or not on the same area of the body, but this same kind of wound?" If the participant indicated they were unfamiliar with the wound type, or if the participant indicated that the patient would immediately be referred, the PI recorded this information and the next case was presented. However, if the participant indicated that the wound type was familiar and within the participant's scope of practice, the PI made a request like, "Tell me the rest of the story: what you would do for this kind of wound." No other prompts were given. When the participant completed their account, the PI asked a question like, "Is there anything you would do before (the first intervention in the story)?" If the participant gave a response, the PI repeated, "Is there anything you would do before that?" until the answer was negative. When the participant had confirmed

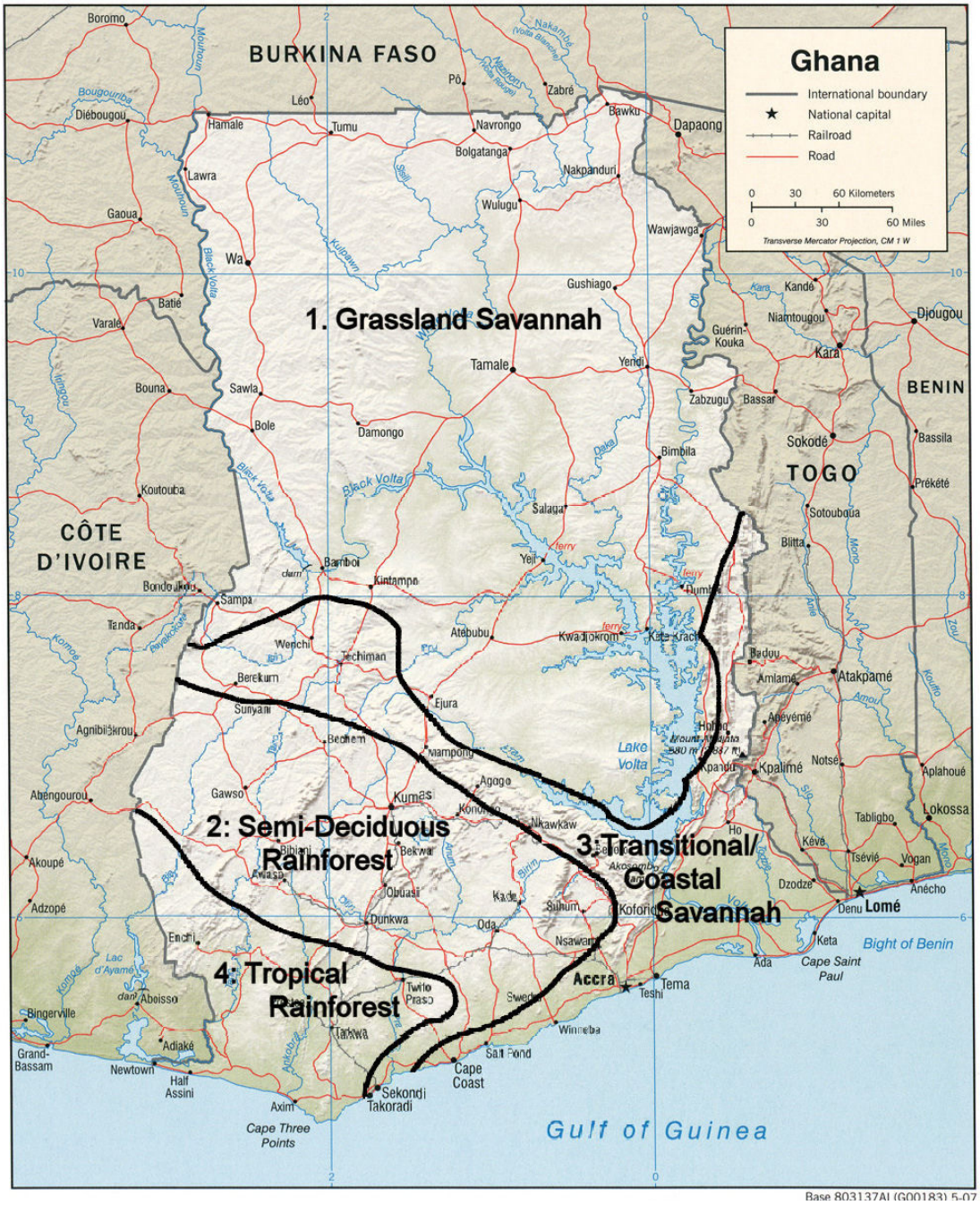
how the wound would be managed initially, the PI asked a question like, “Is there anything you would do after (the final intervention the participant described)?” repeatedly until no new information was given. The PI then repeated back the entire sequence of wound management interventions the participant gave, in the order in which the participant indicated the interventions would be employed, to validate that the answer was complete and fully understood. No prompts were provided. Anything not mentioned was presumed not to be practiced.

The PI also asked the participant the purpose or goal of the intervention when it was unclear. If it was clear from the response that the question was not understood, the PI asked what the wound should look like if it is doing well. Each of the seven representative wound case studies was presented to each participant, using the same procedure to elicit detailed descriptions of usual wound management practices. If a participant demonstrated a technique, the PI described the demonstration so that it would be included in the audio record. When possible, video recordings of demonstrations were also obtained. Although evaluating specific herbal remedies is beyond the scope of this study, when participants supplied examples of herbal remedies, these were photographed so that this valuable information would be available for future studies.

Finally, demographic data were gathered from the participant. This included gender, approximate age, parental status, how long they had been managing wounds, how much training in the healing arts they had undergone, and amount of formal education (schooling). Village data included the ecosystem (grassland savanna, semi-deciduous rainforest, transition/coastal savanna, or

tropical rainforest) because the local ecosystem could influence the indigenous materials used for topical wound management (see Figure 2). Villagers were also asked how accessible the nearest hospital was during the rainy season (the road

FIGURE 2: FOUR ECOSYSTEMS IN GHANA, BASED UPON ALTITUDE & RAINFALL



(map adapted from a public domain world map by the US Government's CIA: Base 803137AI (G00183) 5-07)

is sometimes impassable, even for 4WD vehicles; at times the hospital is accessible only with a 4WD vehicle or it takes more than 2 hours to get to a hospital; or a hospital is always accessible within 2 hours by ordinary taxi).

Originally, the demographic questions included village population data (number of people or huts), but it quickly became apparent that the participants and onlookers had no idea how large their villages are. Population size questions embarrassed the participants and were unanswerable, even by village leaders. Questions about the number of wounds a participant managed in a given month were also unanswerable, particularly in the many areas of Ghana where dates were unknown. Therefore, these two questions were omitted from the study.

Rather than being an “icebreaker,” the demographic questions were often embarrassing to participants who could not readily answer questions such as their age and were ashamed that they had not gone to school. For this reason the demographic questions were moved to the end of the interview, and the first demographic question became, “Do you have children?” which all but two of the 75 participants were able to proudly answer in the affirmative. After the formal interview was concluded, the PI asked VHWs and THPs about compensation for their wound management. These data were not a part of this study.

The PI learned to ask the participants to “finish the story” by relating what they would do for each wound, rather than asking what they would do first. Asking what would be done first, or even, “what would you do before that?” often made the THP look nervous as the crowd roared. It was clear from their comments that they assumed the PI was asking about spiritual rites. Some VSCs

also used magic, and even the VHWs clearly believed that some wounds were the purview of the local shaman.

Logistics

The entire conversation between the PI and the participant, including the interpretation, was recorded by the RA for each participant. A lapel microphone was used to record the interpreter, and a stand microphone was placed on the ground nearby. Both microphones captured the voice of the PI and participant as well. Each microphone was attached to a password-protected Android recording device. The interpreters' role was limited to assisting with communication between the PI, RA, and villagers. Interpreters were not involved in any data analysis or recording of interviews. Both the PI and the RA underwent CITI Human Research Protections training as a part of UTMB's Institutional Review Board approval process.

The PI did not encounter topical wound management practices that were significantly more dangerous to patients than the typical wound management practices encountered in Ghana. If this had been the case, the study protocol stated that the PI would discuss alternative safer wound management practices with the participant immediately following the interview, in an attempt to educate the participant. Once, the PI was led by concerned neighbors to the bedside of a young girl who was being treated for a wound by a THP. She was clearly septic. The PI informed members of the community that this was a medical emergency and encouraged them to find her parents and alert them so that she could be transported to a hospital immediately.

At the conclusion of the interview, each participant was given a small flashlight worth ~$3 with “Improving Village Wound Care” engraved on the side as a practical gift of appreciation for their time. The flashlights were coveted by family members and passers-by. Several of the participants asked to have their photos taken while receiving the flashlight, posing as in an awards ceremony. Only one of the participants asked for a copy of the photograph.

Usually all three interviews in a given village took place on the same day, but sometimes the THP had traveled (was away). Invariably someone was able to contact the missing THP via cell phone to schedule a second visit. At two different villages, the THP interview had to be rescheduled because the THP was too inebriated to carry on a meaningful conversation. These second visits were worth the effort, but they greatly increased the time and expense of collecting data in these villages. On the other hand, several times two villages were near enough to one another that, by making a very long day of it, the PI was able to interview all six participants from both villages in one day.

The original plan to code the recorded data into the spreadsheet on the evening of the interviews proved unworkable because the research team usually traveled from dawn to dusk on interview days. However, after finally coding the first few interviews, the PI made a serious effort to code the remaining interviews within a few days of recording them so that memory could augment hearing. Ambient noise from motorcycles (they can go anywhere!), goats, guineas, cattle, pigs, dogs, roosters, butchers chopping meat, poorly balanced ceiling fans, radios, bystanders, and large trucks all served to make it imperative that the PI

repeat each response more than once so that even if a critical word was obliterated by noise the first two times it was uttered, it would be captured when it was repeated yet again.

Data Management

Villages were assigned numbers and participants were identified using the village number followed only by VHW, THP, or VSC to ensure confidentiality. All interviews were recorded using the previously described redundant password-protected electronic device system. The interview data were coded into the spreadsheet by the PI while still in Ghana, so that problems such as missing data due to inaudible recordings or failure to ask participants appropriate questions could be remedied. Only one interview was found to be deficient on both recordings: a VHW had not been asked the demographic data. This error was easily remedied with a brief supplemental cell phone interview.

The interview recordings were backed up onto a password-protected laptop and a memory stick each evening. Whenever an adequate internet connection was available, the data, including both of the recordings for each interview and the updated spreadsheet and outline, were copied onto a waterproof, fireproof hard drive in the USA via a personal FTP server, so that even if the research team suffered a catastrophic loss of all equipment in Ghana, the data that had already been collected would be intact. After each backup to the USA-based hard drive, the data files were reconciled with those on the laptop, memory stick, and Android devices. Then, the original interview recordings were erased to free up space on the Android devices.

Data Analysis

Coding

The responses from each of the 75 participants for each of the seven wound types were categorized (coded into the spreadsheet) based upon the three domains and six subcategories of topical modern wound management outlined in Table 1 and detailed in Appendix A: wound bed preparation (cleansing, debridement), wound treatments (infection/moisture control, inflammation/edema control), and wound coverings (commercial, indigenous). New items were added to the appropriate section of the outline and corresponding columns were added to the spreadsheet as novel wound management interventions were encountered on the interview recordings during coding. Anything not mentioned was presumed not to be practiced and was coded as not occurring.

When the participants provided samples or the names of the indigenous remedies they used, the PI recorded this information in detail for future studies. Because the PI lacks the botanical expertise to judge efficaciousness or safety of such remedies, coding was based upon the effect the participants stated they expected from these interventions. VHWs and THPs often included treatments to be ingested or spiritual rites in their descriptions of their wound management methods, including pain relievers, systemic antibiotics, and animal sacrifices. These data were also preserved for future studies. However, only the topical portion of the wound management described was coded for this research study.

Subcategory summary fields were coded with 1 if the participant's response was consistent with modern wound management principles and 0 if it was not. In most cases, the participants provided one response (or none) for each subcategory, making the decision on how to code the subcategory automatic (based upon the outline). In the few cases in which more than one response was given and the responses conflicted, the PI judged whether or not the overall effect of the participant's proposed wound management strategy was consistent with modern wound management principles.

Domain fields were coded similarly: If the participant's responses to both subcategories in the domain were consistent, the decision on how to code the subcategory was automatic. On rare occasions, one subcategory was coded 0 and the other was coded 1. In these instances, the PI made a judgment call based upon whether the overall effect would be consistent with modern wound management principles or not. Because the coding decisions were fairly unambiguous, the PI did not solicit verification from a second wound expert.

The PI made an effort to ignore who the participant was (provider type and village) when coding the data. The fact that the ambient noise on many of the interview recordings made the coding extremely challenging may have made this particular attempt to decrease bias easier than it would have been had there been fewer distractions.

Condensing the Data

After the data collection expedition, the PI cleaned the data by removing columns which contained no data on any wound type (all cells were empty). The

final outline of results was reviewed and similar items were combined into categories in a summary outline. For example, “wash with clean water,” “wash with commercial normal saline,” “wash with homemade normal saline,” and “wash with fresh coconut milk” were combined into the new category “wash with noncytotoxic liquid.” A summary spreadsheet with collapsed columns was created based upon this summary outline.

When a participant provided multiple responses which fit into the same collapsed column, for instance, clean with water and then with saline, the collapsed column cell was coded 1. A few participants described interventions which fit into more than one collapsed column within a given subcategory for a particular wound, such as cleansing with saline and then rinsing with an herbal solution. In such cases, both collapsed columns were marked 1. For this reason, the total of all choices in a subcategory can be greater than 100%. Participants’ responses were summarized into subcategories and domains based upon whether or not the response was congruent with modern wound management principles overall. Therefore, these variables always add up to 100%.

Statistical Analyses

The data from the summary spreadsheet was transferred into SPSS for quantitative data analysis. The independent variable in this study was the wound care provider: VHW, THP, or VSC. Dependent variables include the *frequency* of responses of specific wound management practices and the subcategory and domain summary values for each for each wound type (see Appendix A) at the nominal level (yes/no), as well as four groups of calculated aggregated indices

which reflect summary measures at the interval level. The four groups of aggregated indices (Table 2) were: WndSub (6 subcategory indices averaged across all wound types, each with values of 0 - 1), WndDom (3 domain indices averaged across all wound types, each with values of 0 - 1), SubType (7 indices totaling the subcategory summary scores for each wound type, each with values of 0 - 6), and DomType (7 indices totaling the domain summary scores for each wound type, each with values of 0 - 3).

TABLE 2: COMPOSITION OF INDICES

AVERAGED ACROSS ALL 7 WOUND TYPES		SUMMED WITHIN EACH WOUND TYPE	
WNDSUB Mean of Relevant Subcategory scores Range of Values: 0 – 1	WNDDOM Mean of Relevant Domain scores Range of Values: 0 – 1	SUBTYPE Sum of Subcategory scores Range of Values: 0 – 6	DOMTYPE Sum of Domain scores Range of Values: 0 – 3
MEANCLNS	MEANPREP	SUBABSCESS	DOMABSCESS
MEANDBRD		SUBBURN	DOMBURN
MEANTPCL	MEANTRTMNT	SUBULCER	DOMULCER
MEANEDMA		SUBCHRONIC	DOMCHRONIC
MEANCMRCL	MEANDRSG	SUBTRAUMA	DOMTRAUMA
MEANINDG		SUBOSTEO	DOMOSTEO
		SUBCANCER	DOMCANCER

The indices which summarized information across all seven wound types (WndSub, WndDom) were calculated as means, so that the choice not to respond to a particular wound type (an unfamiliar wound type, or a type the participant would refer, rather than treat) would not skew the data. Frequency counts of the wound management qualifying as congruent with modern wound management principles across the seven wound types (one possible point for each wound type = a range of values of 0 - 7) within each subcategory (e.g., cleansing, debridement) were divided by the number of wound types for which the participant provided a description of wound management (also 0 - 7).

This resulted in a mean congruence score for each participant ranging from 0 to 1 for the six *subcategory* indices (MeanClns, MeanDbrd, MeanTpcl, MeanEdma, MeanCmrcl, MeanIndg). These six WndSub indices were then used to calculate the differences and similarities between provider groups at the subcategory level (RQ 2). Mean scores were calculated similarly for the three *domains* across the seven wound types for the three WndDom indices (MeanPrep, MeanTrtmnt, MeanDrsg). Participant scores ranging from 0 - 1 for each of the three domains were used to assess similarities and differences at the domain level (RQ 3).

The SubType and DomType indices were used to assess similarities and differences between provider groups within each wound type (RQ 4). Mean congruence scores were not calculated for SubType and DomType indices because the data sheet was blank across each wound type which a participant would not treat, allowing the PI to automatically omit these participants from the computations of SubType and DomType indices involving a skipped wound type. Thus, a participant would simply have no scores for each of the wound types he or she would not manage. The resulting missing data for some wound types is reflected in the varying sample size for within wound analyses. The SubType indices (SubAbscess, SubBurn, SubUlcer…SubCancer) were constructed by summing the number of congruent practices across the six subcategories of wound management practices *within each wound type*. Scores ranged from 0 to 6 for each of the seven wound types. The same process was followed to obtain summary scores of congruent practices across the three domains of wound

practices within each wound type (e.g. DomAbscess), yielding scores of 0 – 3 for the DomType indices.

Research question (1) was addressed by summarizing the nominal data at all levels using descriptive statistics (modes, percentages), and frequency distribution graphs. The three-factor between-groups comparative study design allowed the independent variables (VHW, THP, and VSC) to be compared across aggregated indexes (WndSub, WndDom, SubType, DomType) using inferential statistics to address Research questions (2), (3) and (4).

Specifically, analyses of variance (ANOVA) were used to determine if any of the provider groups were more likely than the others to use wound management practices that are consistent with modern wound management principles at the subcategory level (WndSub) (RQ2). Analyses of variance (ANOVA) were also used to determine if any of the provider groups were more likely than the others to use wound management practices that are consistent with modern wound management principles at the domain level (WndDom) (RQ3). And, analyses of variance (ANOVA) were used to determine if any of the provider groups were more likely to manage any of the seven wound types with modern wound management principles than the others at either the subcategory (SubType) or the domain level (DomType) (RQ4). Statistical significance was defined as $p \leq .05$. Effect size significance was based upon Cohen (1988, p. 280-287), who suggested that for η_p^2 (used with the analysis of variance calculations), $\eta_p^2 = 0.01$ is a small effect size, $\eta_p^2 = 0.059$ is a medium effect size, and $\eta_p^2 = 0.138$ is a large effect size, and for Cohen's *d* (used with the Student's t-test

calculation), Cohen's *d* = 0.2 is a small effect size, Cohen's *d* = 0.5 is a medium effect size, and Cohen's *d* = 0.8 is a large effect size.

Summary

The information in this chapter demonstrates that this pilot study was designed and implemented in a way that was appropriate to the problem, the questions, and the environment. The study design and procedure were based upon modern wound management principles; these principles also served to organize the data. The research team and study participants interacted using an innovative data collection method designed to overcome the obstacles which often prevent researchers from obtaining meaningful quantitative data in the challenging setting of rural areas of tropical developing countries. Specifics of the data collection procedure were included to guide future researchers in their preparations for similar studies. Finally, all aspects of the data analysis process were described. This chapter provides a detailed template future researchers can adapt to perform a similar study in other tropical developing countries. These studies are needed to reach the goal of developing and disseminating evidence-based, attainable solutions to wound management problems for nonprofessional health care providers in rural areas of these nations.

CHAPTER 4: RESULTS

This chapter begins with a brief review of the study aim and the research questions posed to address the problem of poor wound management in rural areas of tropical developing countries. Next, the chapter relates the demographic characteristics of the participants. Then, the chapter reports the findings which address each of the four research questions in turn. The chapter concludes with a summary of the study results.

Purpose

The aim of this pilot study was to characterize usual topical wound management practices in rural areas of a tropical developing country: Ghana, West Africa. This study is the first step in a plan to design sustainable evidence-based wound management protocols for such settings worldwide. Four research questions provided the study with focus:

1) What are the defining characteristics of the wound management practices of THPs, VHWs, and VSCs in rural areas of Ghana?
2) What are the similarities and differences between wound management *subcategories* (e.g., cleansing, debriding) performed by each of these three provider groups across the seven different wound types?
3) What are the similarities and differences between wound management *domain* practices (e.g., wound bed preparation) performed by each of these groups across seven different wound types?
4) Are there differences in provider practice with respect to wound type (e.g., abscess, burn, ulcer)?

Topical wound management was evaluated using descriptive statistics and compared, within the framework of modern wound management principles, across the three provider types typically providing wound care in villages and across seven representative wound types.

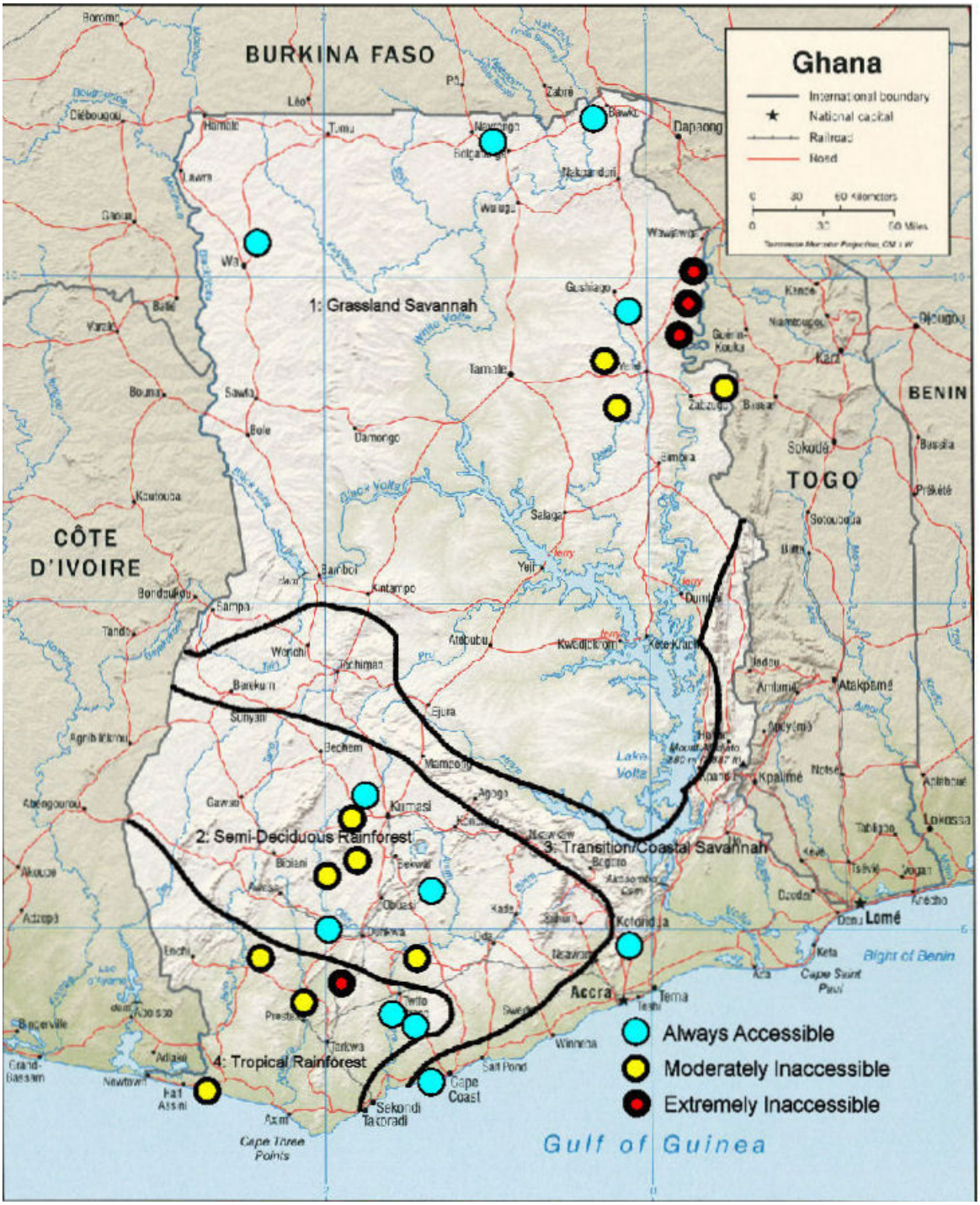
Village Characteristics

Ghana was subdivided into four ecosystems for the purposes of this study: grassland savanna, semi-deciduous rainforest, transition/coastal savanna, and tropical rainforest. The study villages tended to be clustered geographically around the Yendi clinic in the grassland savannah and the Kumasi clinic in the semi-deciduous forest, because these clinics served as training centers for the VHWs who were included in the study. The transition/coastal savanna ecosystem was represented by only two villages, and six study villages were located in the tropical rainforest. One VHW, one THP, and one VSC from each of the 25 villages were interviewed for the study, for a total of 75 participants representing 15 distinct people-groups.

As previously described, accessibility was defined by how accessible the nearest hospital was during the rainy season: extremely inaccessible = the road is sometimes impassable, even for 4WD vehicles; moderately inaccessible = at times the hospital is accessible only with a 4WD vehicle, or it takes more than two hours to get to a hospital; accessible = a hospital is always accessible within two hours by ordinary taxi. Despite the difficulty accessing villages which were not on paved roads, no village was omitted from the study due to lack of accessibility. Four villages were extremely inaccessible, ten were moderately inaccessible,

and eleven were accessible. All of the villages on improved (paved) roads were within 2 hours of a hospital by ordinary taxi. While the specific villages included in the study are confidential, the approximate locations are indicated on Figure 3.

FIGURE 3: ACCESSIBILITY & APPROXIMATE LOCATIONS OF THE 25 STUDY VILLAGES

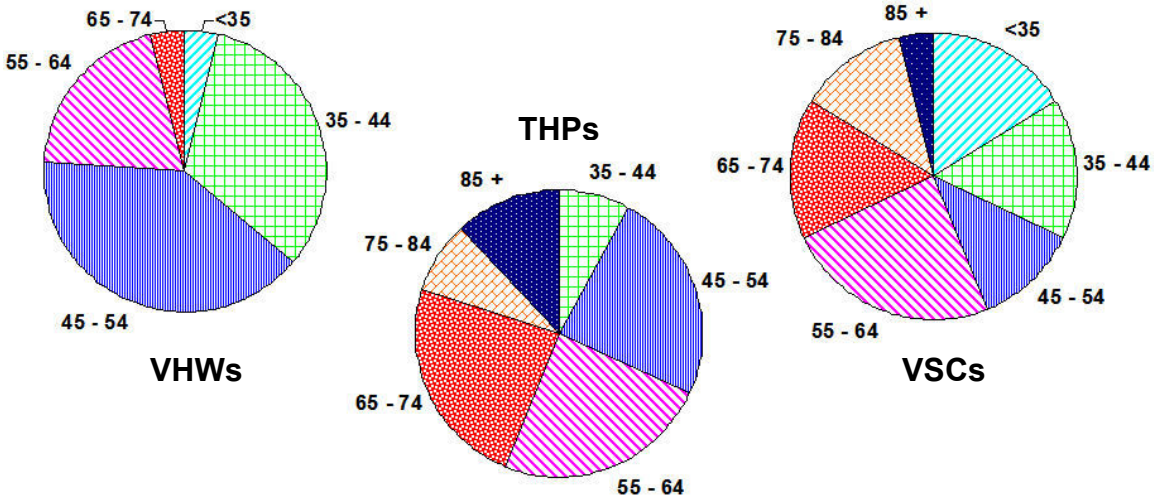


(map adapted from a public domain world map by the US Government's CIA: Base 803137AI (G00183) 5-07)

Participant Characteristics

Table 3 displays descriptive statistics on participant characteristics. Participants in southern Ghana often knew their date of birth. In the north, participants seldom knew the decade in which they were born. In order to estimate the approximate ages of the participants, the PI asked them their stage in life during pivotal events in Ghanaian history, such as if they already had children when JJ Rawlings staged his first coup d'état. The participants and their friends confirmed the estimated ages. The median approximate ages for participants were 53 overall, 48 for VHWs, 55 for VSCs, and 60 for THPs, with a range of 24 to ~85. The oldest and youngest participants were VSCs (see Figure 4).

FIGURE 4: AGE DISTRIBUTION OF PARTICIPANTS, BY PROVIDER TYPE



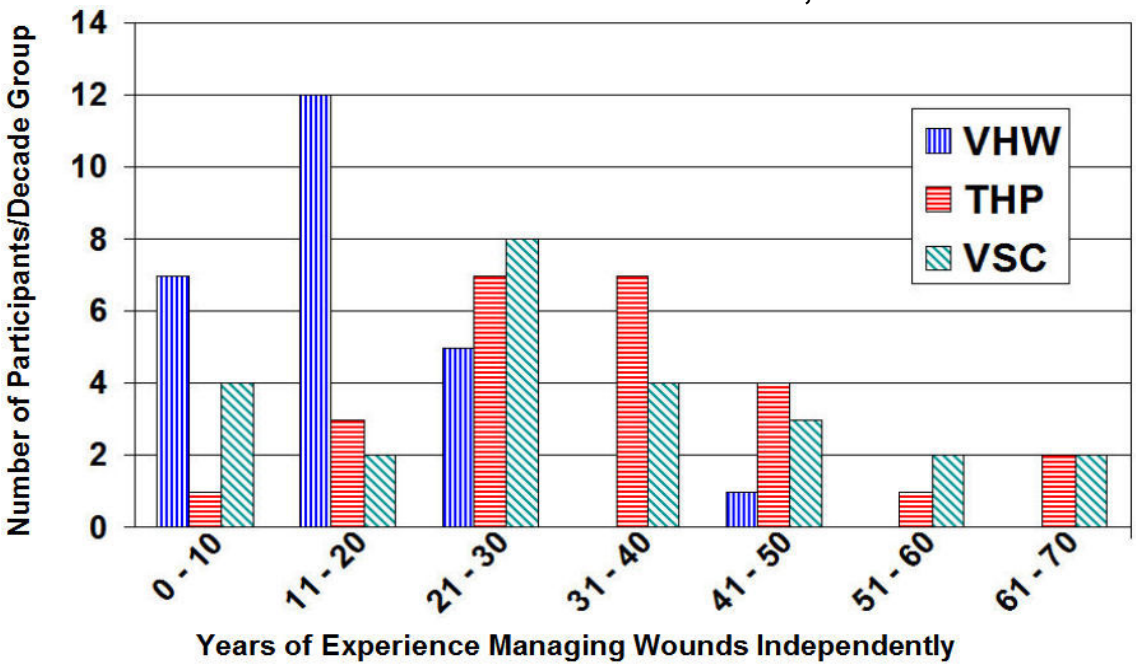
As was anticipated, most of the VHWs and THPs were male. The PI's concerted effort to recruit female study participants yielded one VHW, two THPs, and sixteen VSCs. The remaining 56 participants were male. Only one VHW and one THP were not parents (see Table 3).

TABLE 3: PARTICIPANT DEMOGRAPHICS															
	VHWs					THPs					VSCs				
	N	%	Mean	SD	Median	N	%	Mean	SD	Median	N	%	Mean	SD	Median
	Approximate Age of Participants														
<35	1	4	47.56	10.583	48	0	0	62.00	13.257	60	4	16	54.08	17.246	55
35 – 44	8	32				2	8				4	16			
45 – 54	10	40				6	24				3	12			
55 – 64	5	20				6	24				6	24			
65 – 74	1	4				6	24				4	16			
75 – 84	0	0				2	8				3	12			
85 +	0	0				3	12				1	4			
	Gender														
Male	24	96	na	na	na	23	92	na	na	na	9	36	na	na	na
Female	1	4				2	8				16	64			
	Parental Status														
Is a Parent	24	96	na	na	na	24	96	na	na	na	25	100	na	na	na
Is Not a Parent	1	4				1	4				0	0			
	Approximate # of Years of Wound Management Experience														
0 – 10	7	28	16.24	9.554	14	1	4	35.92	14.841	35	4	16	32.76	19.156	30
11 – 20	12	48				3	12				2	8			
21 – 30	5	20				7	28				8	32			
31 – 40	0	0				7	28				4	16			
41 – 50	1	4				4	16				3	12			
51 – 60	0	0				1	4				2	8			
61 – 70	0	0				2	8				2	8			
	Years of Formal Education														
None	1	4	11.48	3.229	12	15	60	2.80	4.564	0	14	56	2.92	4.481	0
1 – 3	0	0				4	16				4	16			
6 – 10	8	32				4	16				6	24			
12+	16	64				2	8				1	4			
	Types of Wound Management Training														
Revelation; Trial & Error	0	0	na	na	na	5	20	na	na	na	5	20	na	na	na
Brief Course	11	44				0	0				0	0			
Additional Courses	8	32				0	0				0	0			
Apprentice Only	0	0				19	76				19	76			
Courses + Apprentice	6	24				1	4				1	4			

N = Number of participants SD = Standard deviation

The median amount of wound experience estimated for all groups was 25 years, with VHWs reporting a median of 14 years, VSCs 30 years, and THPs 35 years. At one extreme, two VSCs stated that they had zero years of experience; at the other, two VSCs and one THP claimed seventy years of experience managing wounds (see Figure 5).

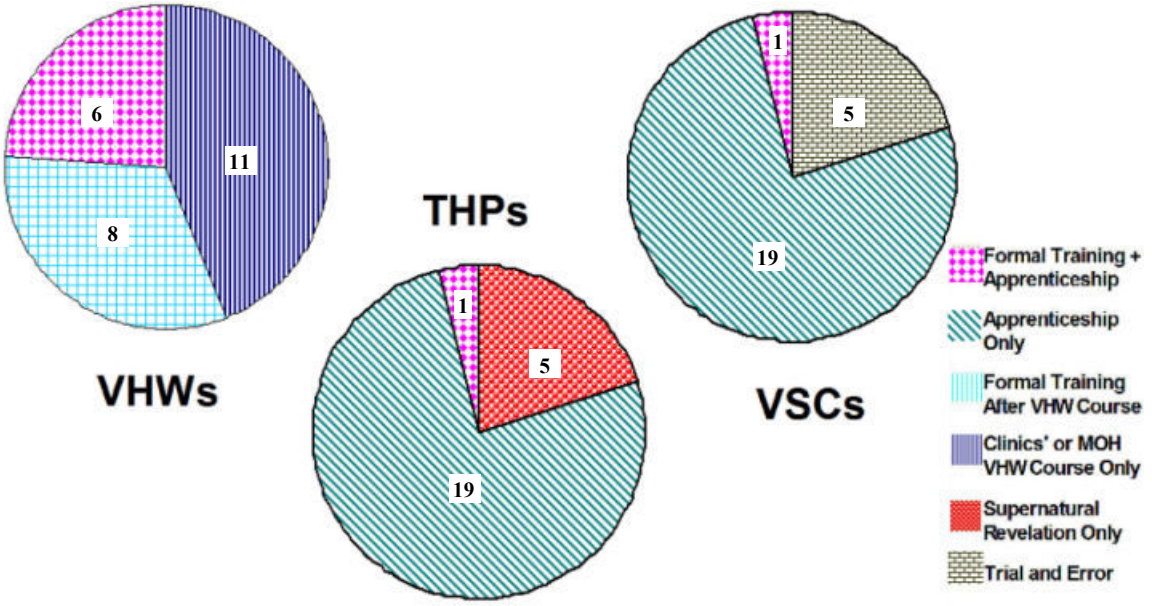
FIGURE 5: PARTICIPANTS' WOUND EXPERIENCE, BY PROVIDER TYPE



Most of the VHWs did not manage wounds prior to their initial formal VHW training through the Yendi and Kumasi clinics. These courses took place intermittently between 1987 and 2003. However, six VHWs had acquired wound knowledge from grandparents and two had been taught by the Ghanaian Ministry of Health prior to attending a clinic course. Twenty of the THPs learned their trade from older relatives as apprentices. Of these, one also had extensive formal training through the Red Cross. The remaining five THPs reported that their wound management knowledge came from dreams, dwarves, deceased relatives, or other spiritual revelations. Twenty of the VSCs also learned wound

care from older relatives, with one having additional formal training from a VHW. The remaining five VSCs learned wound management through trial and error see Figure 6). These differences are consistent with the differences between supernatural healers in Mexico, who claim to receive guidance from dreams, and their naturalistic healer counterparts, who claim to learn their trade through trial and error (Huber & Anderson, 1996).

FIGURE 6: TYPES OF WOUND MANAGEMENT TRAINING

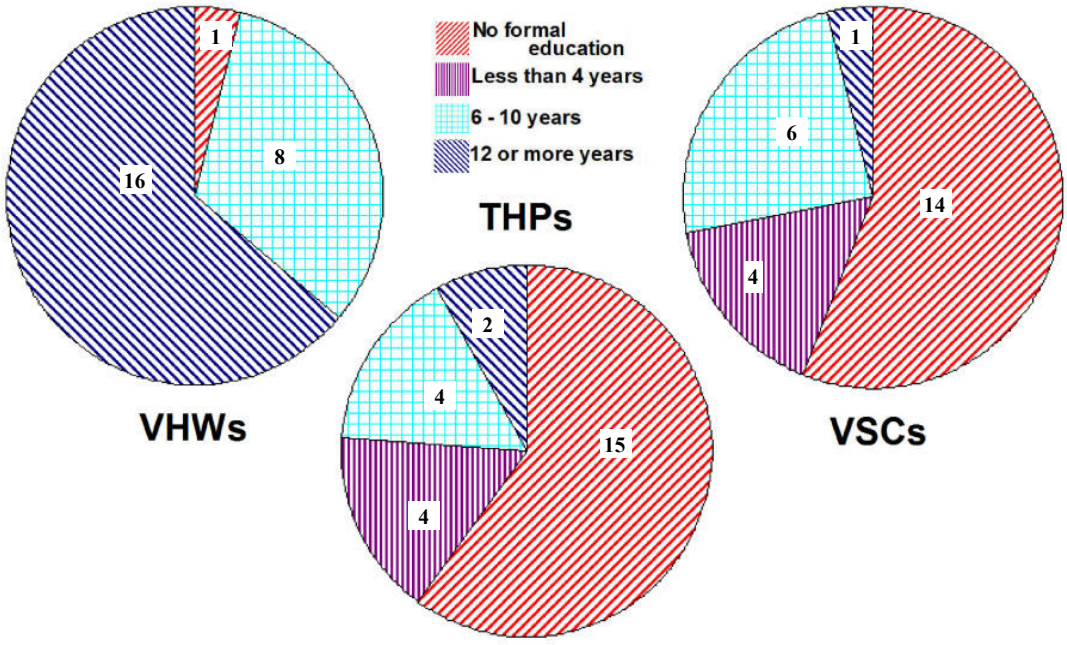


Eleven of the VHWs had only attended the initial clinics' course, while eight (including the two mentioned previously) had additional formal training from the Ministry of Health and/or the clinics' refresher courses. Six VHWs were certified to treat Buruli Ulcer and/or took required continuing education courses as Licensed Chemical Sellers. Additional formal wound management training was not always beneficial. One VHW described wound management that included washing the wound bed with alcohol (a cytotoxic substance) and pouring the powder from an antibiotic capsule into the wound bed (which would dry the wound excessively, delaying healing, and could foster antibiotic resistant

bacterial strains). He stated that these practices, which are not congruent with modern wound management principles, were advocated by the District Medical Officer at a recent seminar for Licensed Chemical Sellers. This seminar had "untaught" the VHW the beneficial practices he had learned in a VHW refresher course several years earlier.

Figure 7 displays the distribution of formal education across providers. Two THPs, one VSC, and 16 VHWs had completed senior high school. Of these, one THP, the one VSC, and nine VHWs had been to college. However, most of the THPs (15) and VSCs (14) had no formal education at all. Many of them expressed regret and felt the need to tell stories of how they were barred from school by their fathers, or in the case of one woman, the older man to whom she had been promised as a bride. Only one VHW was self-taught; the remainder had at least eight years of formal education (were junior high school completers).

FIGURE 7: YEARS OF FORMAL EDUCATION FOR EACH PROVIDER TYPE



Study Questions

Research Question 1: Identifying Topical Wound Practices in Villages

Each wound management intervention described by each participant for each of the seven wound types was coded into a spreadsheet. New columns were added to as needed to capture unanticipated practices described in the interviews. After the study was completed, columns for choices not mentioned by any participant were deleted. The results were then summarized by collapsing columns into like categories to identify the defining characteristics of the wound management practices of THPs, VHWs, and VSCs in rural areas of Ghana.

Results were organized by the purpose of each intervention, based upon domains and subcategories derived from modern wound management principles, subdivided into practices which are congruent with those principles and those which are incongruent. Table 4 shows the percentages of participants who described each intervention for each of the seven wound types, with separate columns for congruent (C) and incongruent (I) practices. Each of the six subcategories of modern wound management interventions will be discussed in turn, with an accompanying graph. Interventions may add up to more than 100% when participants provided multiple wound management strategies within a single subcategory. For example, a response might include washing a wound with water and then bathing it in an herbal decoction.

Cleansing

The most popular congruent method of cleansing wounds was washing the wound bed with a clean noncytotoxic liquid such as water or normal saline

TABLE 4: SUMMARY DATA FOR RESEARCH QUESTION 1

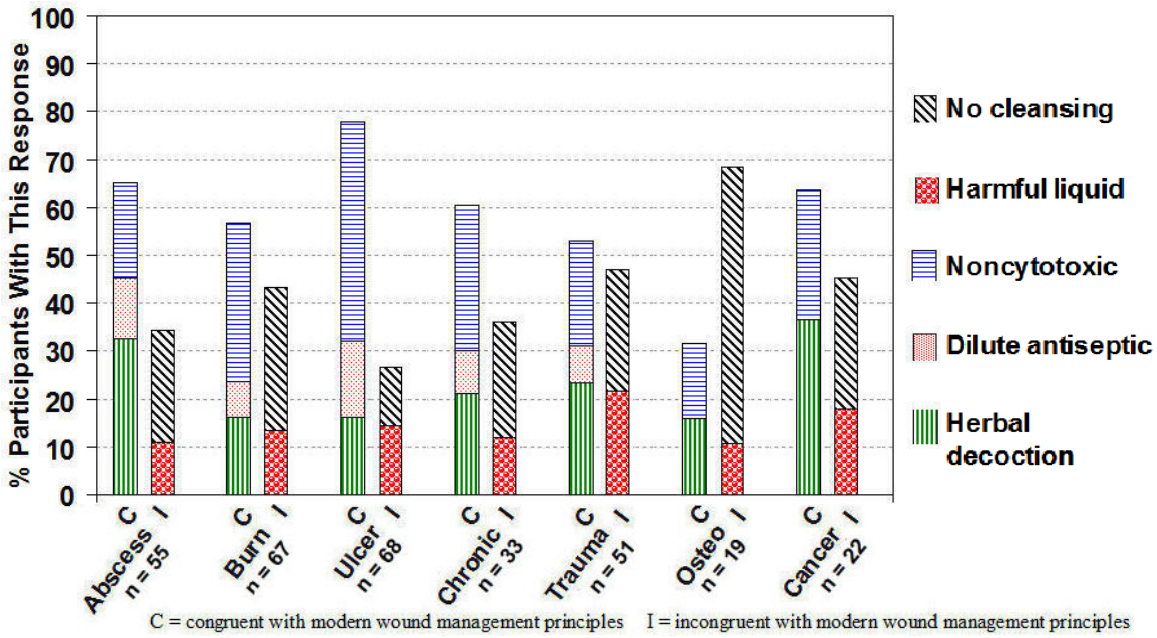
	Percentage of Participants Who Described Each Intervention for Each Wound Type Data Summarized into Subcategories by Overall Purpose																			
		Abscess			Burn			Ulcer			Chronic			Trauma			Osteo			Cancer		
	#Unfamiliar/Refer/**Described**	1	19	**55**	0	8	**67**	0	7	**68**	16	26	**33**	1	23	**51**	21	35	**19**	25	28	**22**
	Wound Interventions	C*		I*	C		I	C		I	C		I	C		I	C		I	C		I
Cleanse	Use noncytotoxic liquid to cleanse wound bed	20			32.8			45.6			30.3			22.0			15.8			27.3		
	Use dilute antiseptic	12.7			7.5			16.2			9.1			7.8			0			0		
	Use herbal solution	32.7			16.4			16.2			21.2			23.5			15.8			36.4		
	No cleansing			23.6			29.9			11.8			24.2			25.5			57.9			27.3
	Use cytotoxic liquid			10.9			13.4			14.7			12.1			21.6			10.5			18.2
Debride	Cleanse "very well"	9.1			11.9			16.2			24.2			27.5			5.3			9.1		
	Sharp debridement, drain abscess	29.1			21.2			2.9			0			11.8			5.3			0		
	Papaya or sugar, monitored	1.8			3.0			11.8			15.6			0			0			4.5		
	Autolytic debridement, use a drawing poultice	58.2			22.4			66.2			48.5			39.2			52.6			40.9		
	No debridement			9.1			29.9			14.7			21.2			33.3			36.8			47.6
	Traumatize the wound bed, break intact blisters			1.8			22.4			1.5			0			2.0			0			0
Topical Treatment	Apply clean shea, oils, or fats to the wound bed	9.1			14.9			5.9			12.1			7.8			5.3			9.1		
	Other clean organic	52.7			37.9			41.2			66.7			47.1			47.4			71.4		
	Petrolatum or antibiotic ointment, applied thickly	12.7			22.4			11.8			0			5.9			0			9.1		
	Apply saline-soaked bandage, trauma: suture	5.5			1.5			7.4			12.1			7.8			5.3			0		
	Povidine or diluted antiseptic bandage	10.9			3.0			11.8			12.1			9.8			5.3			0		
	Infection-breeding or overly drying substance			1.8			16.4			14.7			0			19.6			36.8			9.1
	Cytotoxic substances			10.9			16.4			11.8			3.0			3.9			5.3			9.1
Edema Control	Anti-inflammatory or blister deflating substances	10.9			29.9			5.9			15.2			0			0			13.6		
	Elevation, wraps, cold, heat (abscess)	63.6			40.9			69.1			48.5			62.7			52.6			54.5		
	No treatment for inflammation or edema			25.5			20.9			16.2			33.3			33.3			36.8			40
	Clearly destructive choices, dry open wound			0			13.4			10.4			6.1			3.9			15.8			0
Bandages	Commercial materials to keep clean & moist	50.9			35.8			67.2			48.5			60.8			47.4			45.5		
	Bandages removed dry, tearing wound			7.3			4.5			7.4			3.0			9.8			10.5			0
	Open to air (no dressing)			12.7			19.4			7.4			12.1			13.7			5.3			22.7
Covering	Concoctions seal, keep wound moist	27.3			23.9			19.1			24.2			21.6			31.6			40.9		
	Thickly apply oil-based concoctions	14.5			16.4			11.8			12.1			7.8			5.3			13.9		
	Dry or adherent			3.6			16.4			13.2			21.2			11.8			21.1			9.1

= Number of participants: unfamiliar with the wound type/would refer such patients/**described treatment**
*C = congruent with modern wound management principles, I = incongruent

(see Figure 8). Participants used both homemade and commercial saline. Every participant who stated that they would wash a wound with water specified water

from a borehole or other clean source, or explained that boiled water should be used. Most of these participants also specified that boiled water should be cooled before it is used to wash a wound.

FIGURE 8: METHODS OF CLEANSING DESCRIBED BY PARTICIPANTS



Almost as many participants soaked leaves or roots in water and then used that water to wash the wound. One participant stated that he would use fresh coconut milk, which is also noncytotoxic, to cleanse the ulcer and trauma wounds. Some participants would cleanse dirty wounds with dilute antiseptics (EUSOL, Dettol, or hydrogen peroxide) or strong salt solution (such as, in one case, ocean water from a very loud, powerful wave). One participant would use soap and water for the abscess and the chronic wound, and two others would use soap and water for the trauma wound. These were all coded as congruent.

Many participants omitted cleansing completely, which was coded as incongruent with modern topical wound management principles. Washing the wound bed with any full-strength cytotoxic substance, including mentholated

spirit (alcohol), antiseptics, salt petre, lime juice, gin, or akpeteshie (a very strong local alcoholic drink) was also coded as incongruent, as was washing with urine.

Cotton wool or gauze for applying cleansing liquids was often mentioned as desirable, but expensive and difficult to obtain. Participants from all three provider groups described using sasa, the soft, absorbent, boiled fibers of a plantain stalk, in lieu of cotton wool. Described cleansing was congruent more often than not for all wound types, with the exception of the osteomyelitis wound.

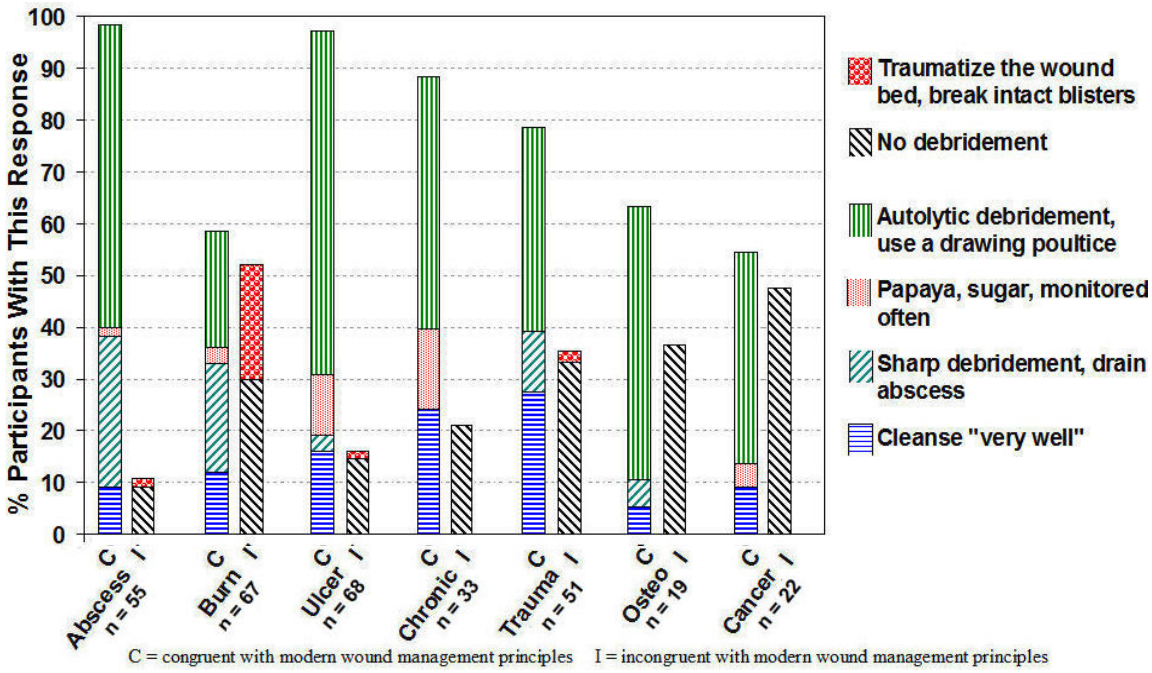
Debriding

Study participants usually debrided wounds by applying herbal poultices or occlusive dressings (see Figure 9). Because these interventions would keep the wound bed moist and promote autolytic debridement, they are congruent with modern topical wound management principles. Some of the participants would simply cleanse “very well” with sasa. This was coded as congruent because scrubbing until bleeding tissue is reached leaves a clean wound. Herbal poultices or Dithranol were used to draw purulent drainage out of infected wounds, or to draw the stick fragments from the trauma wound. One participant would suck the pus out of the ulcer, which would risk his own health, but would likely be safe and effective for the patient.

Only a few participants mentioned papaya, which can be effective for removing necrotic tissue, but must be frequently monitored. Sugar was mentioned in hushed tones by several of the VHWs, who were relieved when the PI reassured them that its use for debriding dirty wounds is accepted practice. The abscess and burn were the wounds most likely to be treated with sharp

debridement. Draining the abscess or removing loose skin from broken blisters is congruent with modern topical wound management principles.

FIGURE 9: METHODS OF DEBRIDING DESCRIBED BY PARTICIPANTS



Participants were asked specifically about the burn blisters: One in five stated they would deroof intact blisters, which is not congruent with modern wound management principles. Participants representing every provider type and ecosystem expressed confidence that if the finely ground white powder from the burnt shell of the black-fleshed snail was applied to intact burn blisters, the blisters would deflate quickly and the burns would heal without scarring. One VHW asserted that this powder is known to have anti-inflammatory properties. Because the blisters remained intact, the PI coded this treatment as congruent with modern wound management principles. Determining the veracity of the various claims regarding snail shell powder would be beneficial; however, it is beyond the scope of this study.

Most of the participants would refer the osteomyelitis and cancer wounds. The participants who provided descriptions of how they would manage these wounds often did not include debriding them. One participant would repeatedly burn the trauma wound with a hot stone and a leaf “to kill the tetanus.” This and no wound debridement at all were both coded as incongruent with modern topical wound management principles.

What the participants, who were identified by their communities as wound experts, did not say was as informative as what they included. Although other researchers report and the PI has personally witnessed kerosene, gasoline, and other petrochemicals being used on wounds by individuals in rural areas of tropical developing countries, none of the study participants mentioned these toxic choices, even when discussing the bleeding trauma wound. The honey sold in Ghana is dark in color and less viscous than that sold in other countries; none of the participants mentioned honey as a topical treatment for wounds.

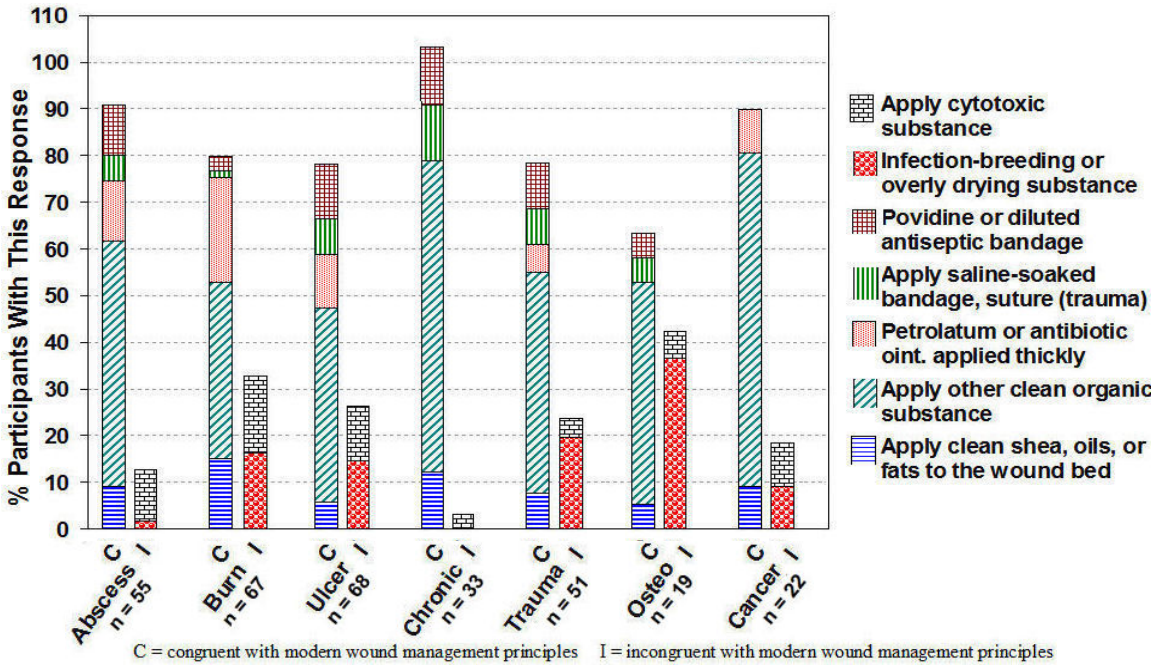
Maggots were universally described as harmful. The PI’s clinic patients in years past who inadvertently had maggots under their dressings complained of excruciating pain until the dressings were removed and the maggots could be extracted. It is likely that the strains of maggots commonly found in Ghana are varieties which do not limit themselves to dead tissue. Some THPs were particularly emphatic that certain wounds, such as the osteomyelitis, contained “worms” which were preventing healing.

Infection/Moisture Control Measures

By far the most common treatments for wounds were organic poultices,

which usually consisted of mashed fresh leaves, but could also be clay, mud, or egg (see Figure 10). All of these provide a clean moist wound environment that is congruent with modern wound management principles. Only two providers mentioned using a slick plant-based substance on a wound; in both instances, it was only used on the burn. Aloe was not mentioned. A thick layer of petrolatum (Vaseline) was used alone, or sometimes mixed with antibiotic powder, particularly for the burn wound, but also for the abscess, ulcer, and cancer wound. Rarely, commercial antibiotic ointment (usually penicillin) was used.

FIGURE 10: METHODS OF INFECTION/MOISTURE CONTROL DESCRIBED BY PARTICIPANTS



Local emollients used to keep wounds moist and uninfected included shea butter (which must be warmed prior to use) and local cooking oils such as palm kernel oil, red palm oil, goat fat, or coconut oil. These were often mixed with various herbal remedies. One provider mixed burnt snail shell powder with shea butter for open burn wounds. Some providers applied a cloth or gauze soaked

with saline, or a diluted antiseptic (Dettol, hydrogen peroxide, EUSOL, or alum), or povidone-iodine on the wound, covering it with more cloth to keep it from drying out. All of these practices were coded as congruent with modern wound management principles.

Because suturing can be appropriate for some trauma wounds, when the rationale and precautions were adequately described, suturing the trauma wound was coded as congruent. For the weeping, highly exudative chronic wound, ashes from leaves or roots or dry ground leaves used to absorb excess moisture and antibiotic powders were also coded as congruent with modern wound management principles.

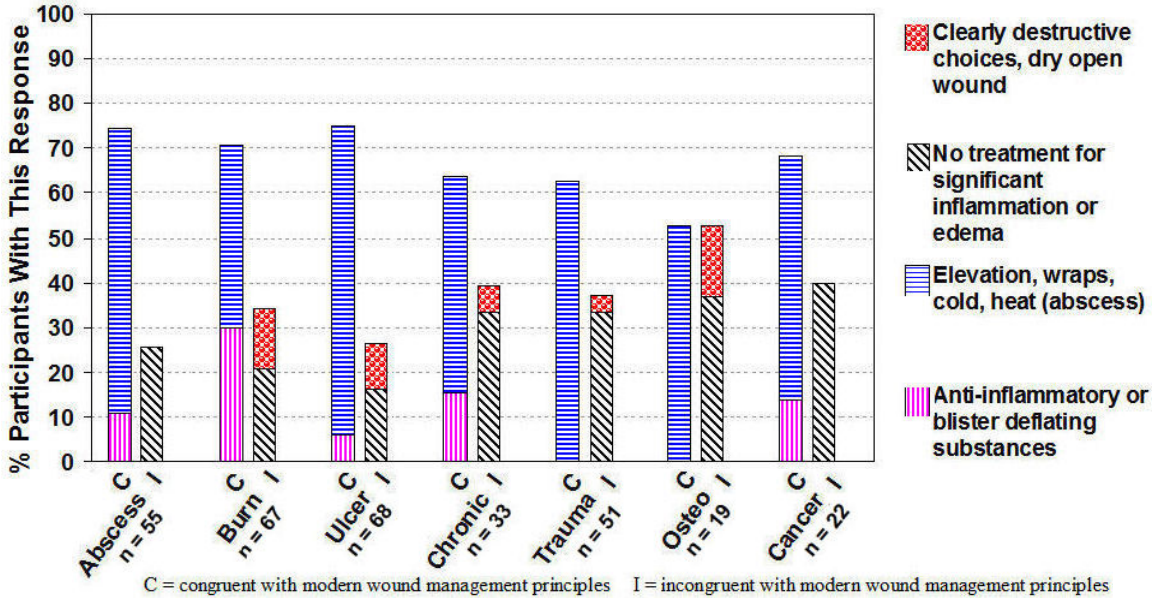
In wound beds which were not highly exudating, dry substances, including ashes, sand, salt, powder from the aforementioned snail shell, antibiotic powders, ground dried leaves, roots, or bark, and other dry substances the participant would not divulge were all categorized as incongruent. Full-strength antiseptics (alcohol or EUSOL), as well as a tree bark which was characterized as burning “like pepper” when applied, were assumed to be cytotoxic and were coded as incongruent. The application of excrement (donkey, vulture) or animal parts (monkey or rat’s tails, squirrel’s stomach) is antithetical to controlling infection and was coded as incongruent with modern wound management.

Inflammation/Edema Control Measures

Many of the participants would apply a cloth bandage, gauze, or (rarely) an elastic wrap to a wound in a way which would help to control edema. Some would elevate the wound. One woman, whose language did not have a word for

sling, demonstrated using her head cloth to create a sling to elevate the hand abscess. The participants did not usually have access to ice, some would apply cool water (or heat for the abscess). All of these practices were coded as congruent with the modern wound management goal of decreasing inflammation and preventing edema (see Figure 11).

FIGURE 11: METHODS OF INFLAMMATION/EDEMA CONTROL DESCRIBED BY PARTICIPANTS



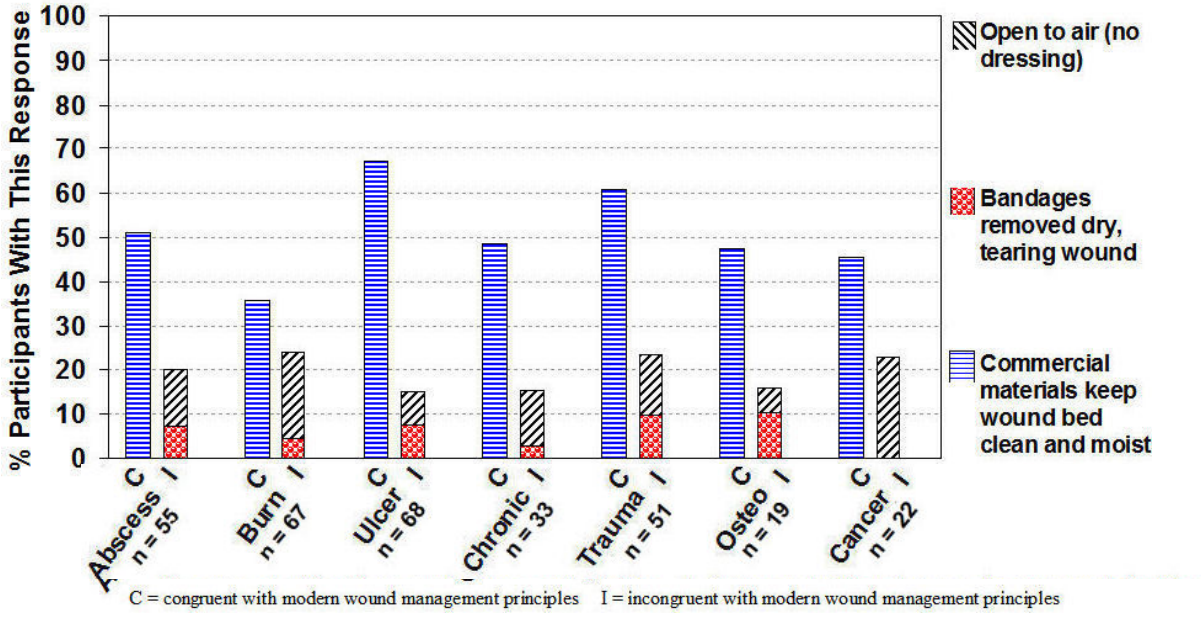
The application of the finely ground white powder from the burnt shell of the black-fleshed snail on intact burn blisters was clearly an attempt at edema control. Some of the moist herbal concoctions were reported to have anti-inflammatory properties as well. These interventions were coded as congruent.

All drying products, including powdered snail shell, applied directly into the wound bed (except in the case of the highly exudative chronic wound), were coded as incongruent with modern wound management principles, because they would cause an inflammatory foreign body reaction. Often the participants did not provide any treatment for significant inflammation and/or edema.

Commercial Wound Dressings

Roughly half of the participants used commercial dressing materials, including clean cloths, gauze, or plasters (adhesive bandages), on each wound type. Although many participants complained that gauze was too expensive and difficult to obtain, members of every provider group used commercial dressings materials, such as strips of old cloth. Often these dressings covered moist leaves or wet cloths or gauze. If the participant stated that the wound bed was kept moist and protected from contaminants by the dressing, even if the dressing had to be soaked off rather than coming off easily, the response was coded as congruent with modern wound management principles (see Figure 12).

FIGURE 12: COMMERCIAL DRESSING METHODS DESCRIBED BY PARTICIPANTS



Of the participants who would manage the cancer wound themselves, one in five would leave it open to air, despite the foul odor and risk of contamination from insects. If the participant would leave a wound bed open to air (no covering) or would tear a dried on commercial dressing off of the wound rather than

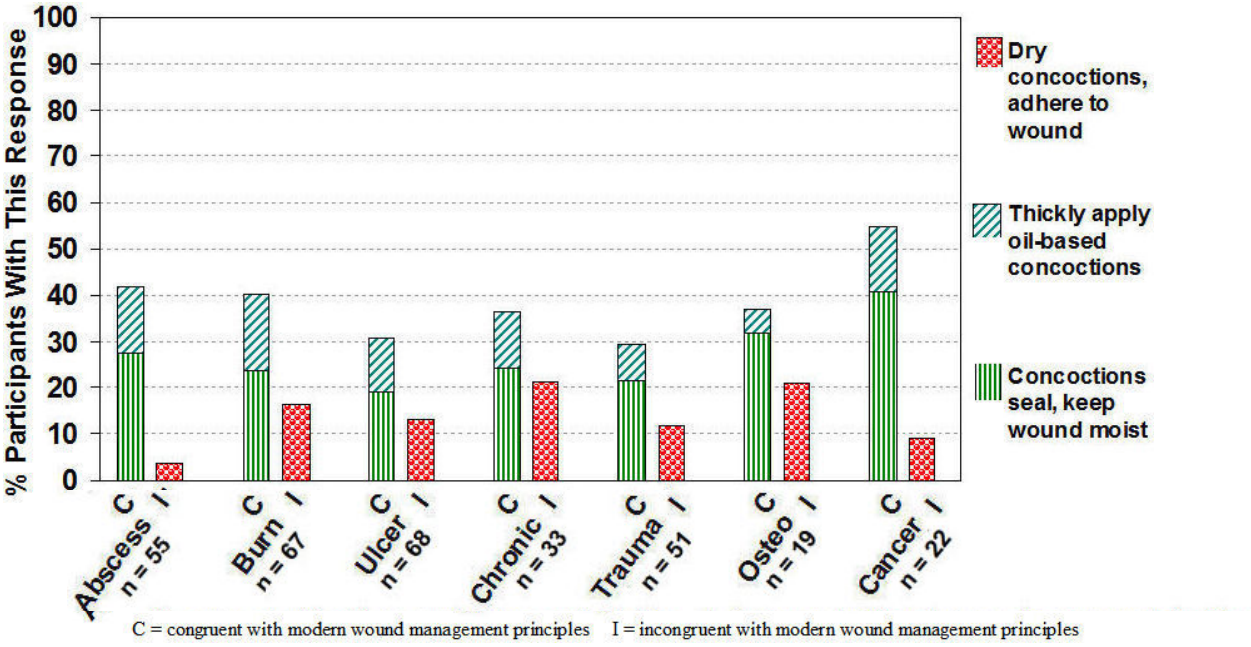
soaking it off, or if the stated goal was to dry a wound bed which was not already overly moist, their response for that wound type was coded as incongruent.

None of the participants described using any modern commercial wound dressings such as hydrocolloids, hydrogels, films, foams, or alginates, or any improvised commercial dressings such as foam rubber or black plastic bags (however, see Chapter 5, Limitations).

Indigenous Dressing Materials

The most commonly described indigenous materials used to dress wounds were herbal poultices which stick to the periwound area and form a seal around the wound (see Figure 13). Oil-based herbal concoctions, thickly applied, also seal wounds from contaminants and keep them moist. None of the VHWs described using indigenous dressing materials.

FIGURE 13: INDIGENOUS DRESSING METHODS DESCRIBED BY PARTICIPANTS



None of the participants reported using banana leaves, but one THP would cover the chronic wound with a plantain leaf. Three THPs and a VSC

stated that they would cover the cancer wound, abscess, and/or chronic wound with a large tree leaf. These dressings were all coded as congruent with modern wound management principles. Powdered leaves, irritants, or other dry substances packed into the wound bed were coded as incongruent with modern would management principles.

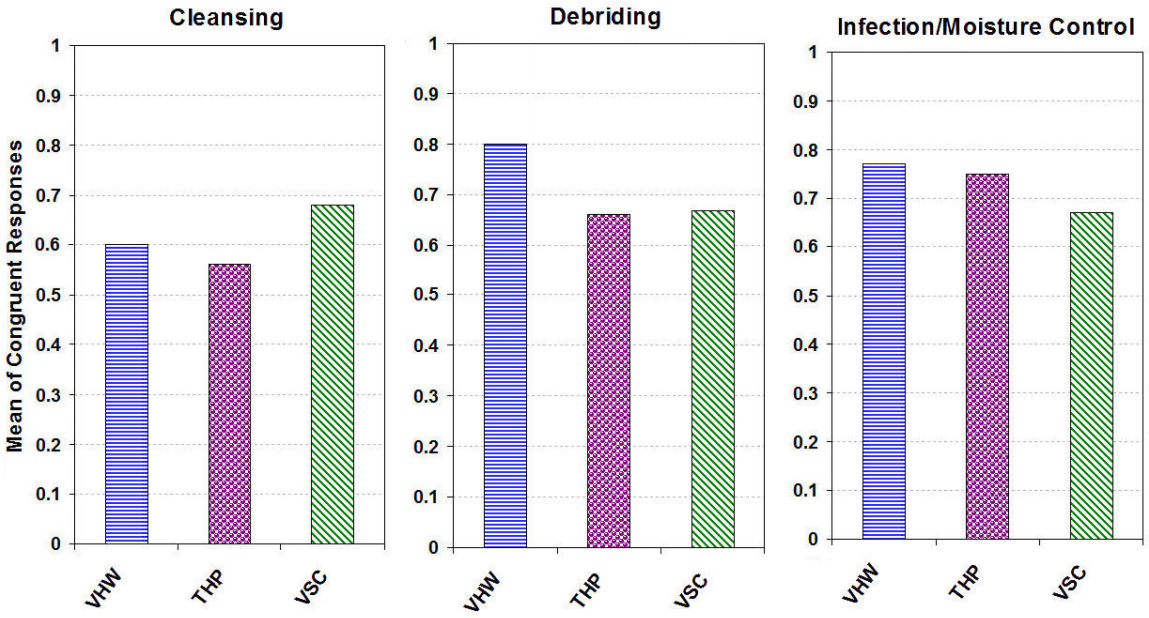
Research Question 2: Subcategories

Research question 2 asked, "What are the similarities and differences between wound management *subcategories* performed by THPs, VHWs, and VSCs across the seven different wound types? This question was addressed by creating aggregate indices for each participant's responses. Their congruent responses for each of the wound types for each subcategory were added together and divided by the total responses they gave, so that the choice not to respond to a particular wound type (an unfamiliar wound type, or a type they would refer, rather than treat) would not skew the data. This resulted in overall mean scores of congruent responses for each participant for each of the identified six subcategories of modern wound management (MeanClns, MeanDbrd, MeanTpcl, MeanEdma, MeanCmrcl, MeanIndg).

The means for each of the six subcategory aggregate indices for the three provider types were compared (see Figure 14 and Figure 15). VSCs were more likely than VHWs or THPs to describe wound cleansing which was congruent with modern wound management principles. VHWs were more likely to describe congruent methods of debridement, infection/moisture control, edema/inflammation control, and commercial dressing use than THPs or VSCs. An examination of the

data revealed that none of the VHWs described using indigenous materials as an outer dressing for any wound type. The data for this subcategory was evaluated further with the VHW information filtered out. THPs were more likely than VSCs to use indigenous dressing materials in keeping with modern wound management principles.

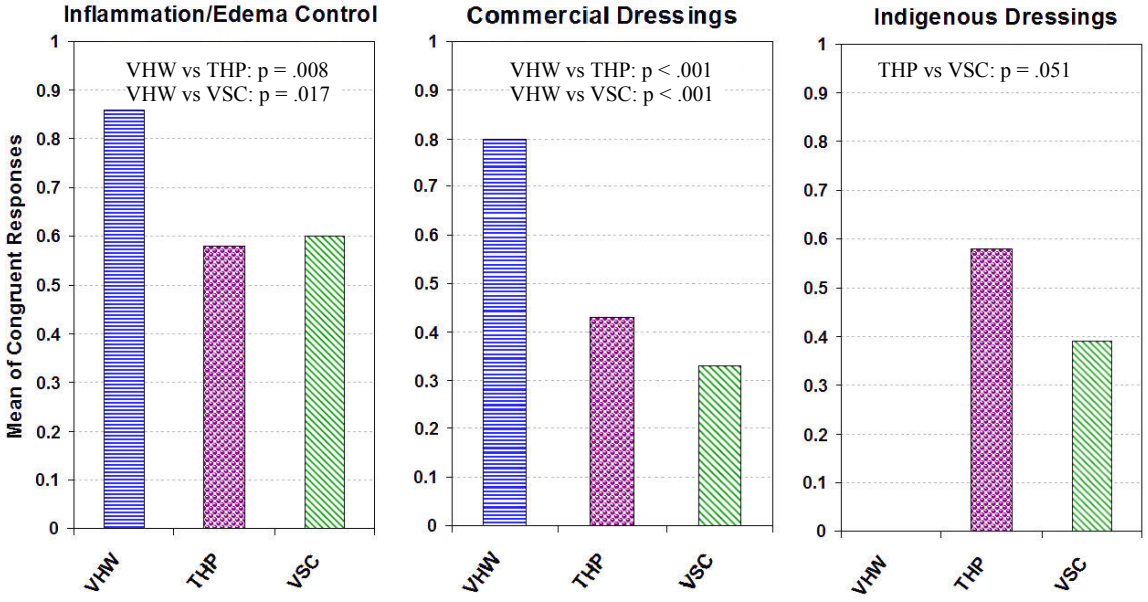
FIGURE 14: SUBCATEGORIES WITH NO SIGNIFICANT DIFFERENCES BETWEEN PROVIDER GROUPS



Analyses of variance were performed on all six subcategory aggregate indices across provider groups (VHW, THP, VSC). Differences between providers were nonsignificant for cleansing, debriding and infection/moisture control with negligible effect sizes (cleansed: $\eta_p^2 = .020$, debrided: $\eta_p^2 = .049$, and infection/moisture control: $\eta_p^2 = .019$) (see Figure 14). The remaining three subcategories displayed significant differences between provider groups (see Figure 15). For edema/inflammation control, the differences between provider groups reached significance between VHWs and THPs ($p = .008$) and between

VHWs and VSCs (p = .017). Analyses of variances for the use of commercial dressings found significant differences between VHWs and THPs (p < .001) and between VHWs and VSCs (p < .001). Lack of VHW data for indigenous dressings directed the use of Student's T-test, which showed that THPs were somewhat more likely (p = .051) than VSCs to use indigenous dressings in a manner which was congruent with modern wound management principles.

FIGURE 15: SUBCATEGORIES WITH SIGNIFICANT DIFFERENCES BETWEEN PROVIDER GROUPS



As would be predicted from significance findings with small sample sizes, the proportions of the variances which were attributable to provider type were large for edema/inflammation control (η_p^2 = .153), and commercial dressing use (η_p^2 = .269). Because Student's T, rather than Analysis of Variance, was used for the Indigenous Dressings data, Cohen's d, rather than η_p^2 was appropriate. Cohen's d for the differences between THPs and VSCs with respect to the use of indigenous dressings identified a medium effect size (d = 0.572).

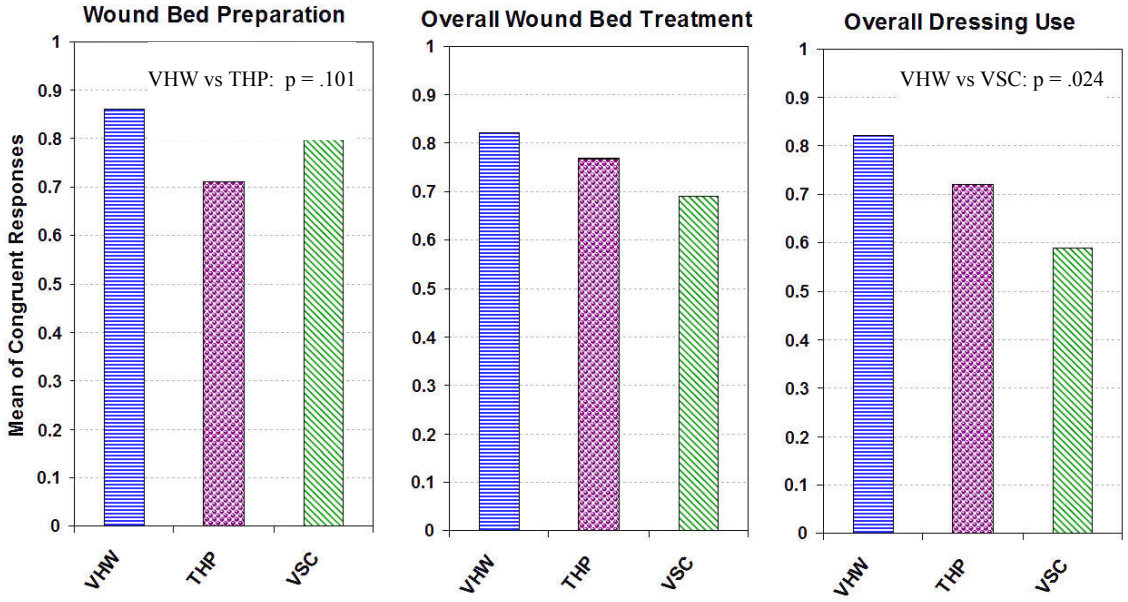
Research Question 3: Domains

Research question 3 asked, "What are the similarities and differences between wound management *domain* practices performed by THPs, VHWs, and VSCs across the seven different wound types?" This question was addressed by creating aggregate indices similar to those created for the subcategories for each participant's domain responses. Congruent responses for each of the wound types for each domain were added together and divided by the number of wounds for which they described topical wound management to avoid data skew from wound types whose management the participants did not describe because they either were unfamiliar with the wound type or would refer the patient. This process resulted in aggregate *means* of congruent responses for each participant for each of the identified three domains of topical modern wound management (MeanPrep, MeanTrtmnt, MeanDrsg).

The means for each of the three domain aggregate variables for the three provider types were compared (see Figure 16). VHWs were more likely to manage wounds in congruence with modern wound management principles in all three of the domains. For wound bed preparation, THPs were the least likely to practice in congruence with these principles; for treatments and for dressings, VSCs were least likely to describe practices which were congruent with modern wound management principles. Analyses of variance showed that the difference between VHWs and THPs for wound bed preparation was marginally significant (p = .101). The differences for dressings were statistically significant (p = .024) between the VHW and VSC provider groups. Effect sizes were small for

treatments (η_p^2 = .040) and medium for wound bed preparation (η_p^2 = .066) and dressings (η_p^2 = .102).

FIGURE 16: DIFFERENCES BETWEEN PROVIDER GROUPS AT THE DOMAIN LEVEL

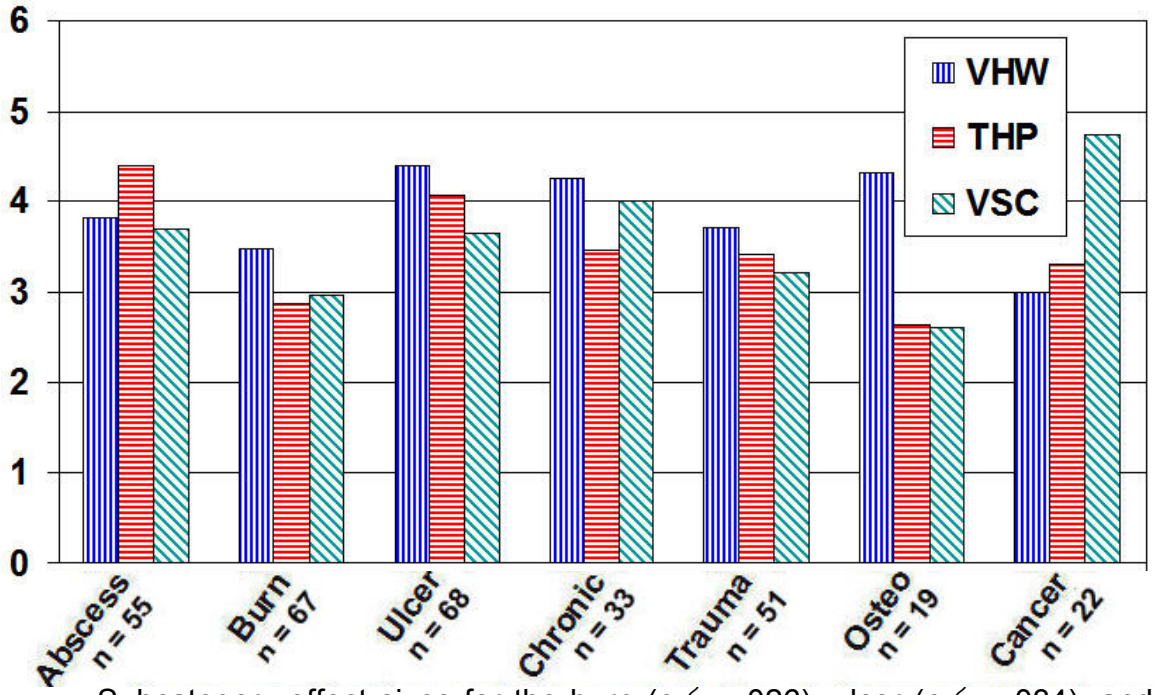


Research Question 4: Differences by Wound Type

Research question 4 asked, "Are there differences in provider practice with respect to wound type?" This question was addressed by again creating aggregate indices for each participant's responses. Two aggregated indices for each wound type were created by summing across components, resulting in seven subcategory summary indices (i.e., SubAbscess, SubBurn, SubUlcer, SubChronic, SubTrauma, SubOsteo, SubCancer) and seven domain summary variables (e.g., DomAbscess, DomBurn, DomUlcer). Wound types not addressed by participants were automatically eliminated from analyses due to missing data for these cases, thereby eliminating the need to calculate mean scores. At the subcategory level, VHWs were the providers most likely to use topical methods congruent with modern wound management principles when treating burns,

ulcers, chronic wounds, trauma wounds, and osteomyelitis (see Figure 17). THPs were most likely to use congruent methods for abscesses and VSCs were most likely to use congruent methods for cancer wounds. Analyses of variances revealed none of these differences as statistically significant. However, because Levene's Test for homogeneity of variances was significant for the ulcer wound, the analysis was conducted using nonparametric ANOVA Kruskall Wallis for the overall model and Mann Whitney U analyses for post hoc comparisons across provider types as well. Results failed to reach statistical significance for any wound type. Only 19 participants would manage, rather than refer, the osteomyelitis wound, and only 22 participants would manage the cancer wound.

FIGURE 17: AVERAGE CONGRUENT TOTALS FOR SUBCATEGORIES, BY PROVIDER TYPE

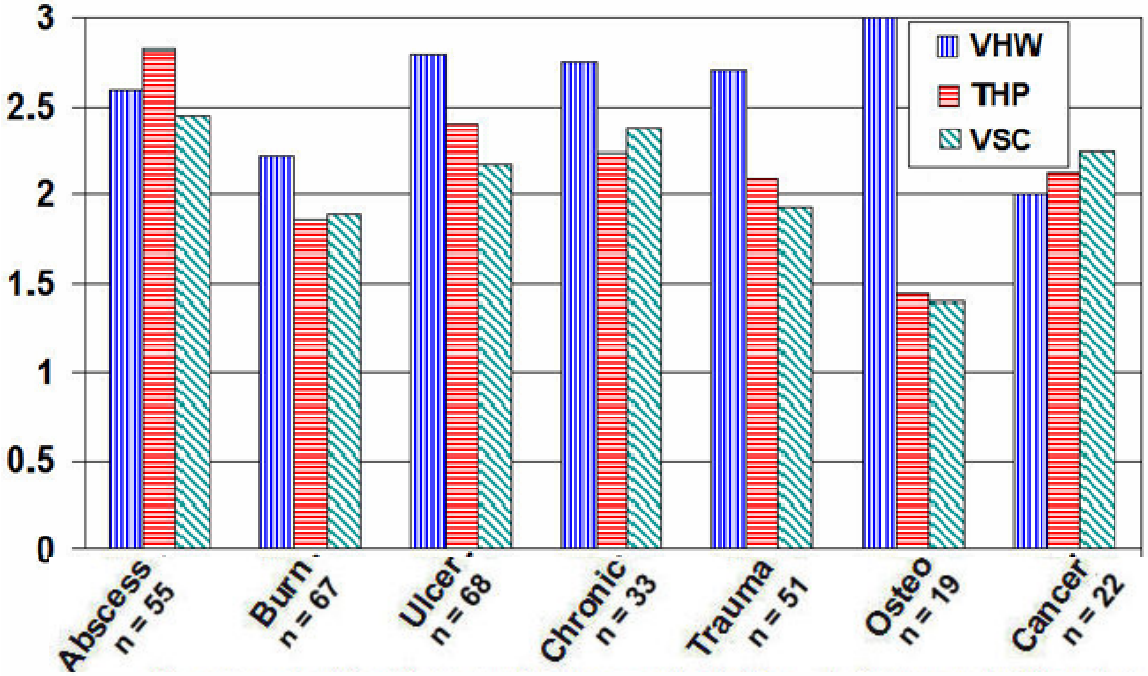


Subcategory effect sizes for the burn (η_p^2 = .026), ulcer (η_p^2 = .034), and trauma wounds (η_p^2 = .016) were small, and for the abscess (η_p^2 = .071), chronic wound (η_p^2 = .066), osteomyelitis (η_p^2 = .116), and cancer wound (η_p^2 = .081) were medium. Consideration of effect sizes for small groups is especially

important in cases where statistical significance fails to be achieved, as there may be clinically important effect sizes indicated that fail to be statistically significant simply due to sample size. The medium effect sizes identified for abscess, chronic wound, osteomyelitis and cancer are notable for this reason.

At the domain level, VHWs were again the providers most likely to use topical methods congruent with modern wound management principles when treating burns, ulcers, chronic wounds, trauma wounds, and osteomyelitis, with THPs most likely to use congruent methods for abscesses and VSCs most likely to use congruent methods for cancer wounds (see Figure 18). Analyses of variance found no statistically significant differences between provider groups. However, Levene's Test of homogeneity of variances found multiple significant homogeneity issues and the Tamhene's 2 post hoc comparison was used to test for significant differences between provider types for ulcers and osteomyelitis.

FIGURE 18: AVERAGE CONGRUENT TOTALS FOR DOMAINS, BY PROVIDER TYPE



Due to the conservative adjustment when using Tamhane's 2 in post hoc analyses and the varying and small sample size, nonparametric tests at the domain level were appropriate. Kruskall Wallis nonparametric analyses of variance revealed a significant difference between groups for the trauma wound and a marginally significant difference between groups for the ulcer. Therefore, Mann-Whitney U's were run between each provider pair (VHW-THP, VHW-VSC, and THP-VSC) for the seven wound types at the domain level to assess post hoc differences. Differences in the degree of congruity of care with modern wound management principles were far from reaching significance at the domain level between THPs and VSCs for each of the wound types. However, VHWs were significantly more likely than VSCs to manage the ulcer wound (p = .025) and the trauma wound (p = .041) in congruence with modern wound management principles at the domain level, and VHWs were somewhat more likely than THPs (p = .083) to manage the trauma wound congruently at the domain level.

Only three VHWs responded that they would manage the osteomyelitis wound, rather than referring this wound type. There was a marginally significant difference between VHWs and THPs (p = .060) and between VHWs and VSCs (p = .071) despite this low n, with VHWs more likely to manage the osteomyelitis wound in congruence with modern wound management principles than the other two provider types at the domain level with a fairly large effect size (η_p^2 = .237). Effect sizes at the domain level within wound types were small for the burn (η_p^2 = .020), and cancer wound (η_p^2 = .003) and medium for the abscess (η_p^2 = .062), ulcer (η_p^2 = .078), chronic wound (η_p^2 = .096), and trauma wound (η_p^2 = .095).

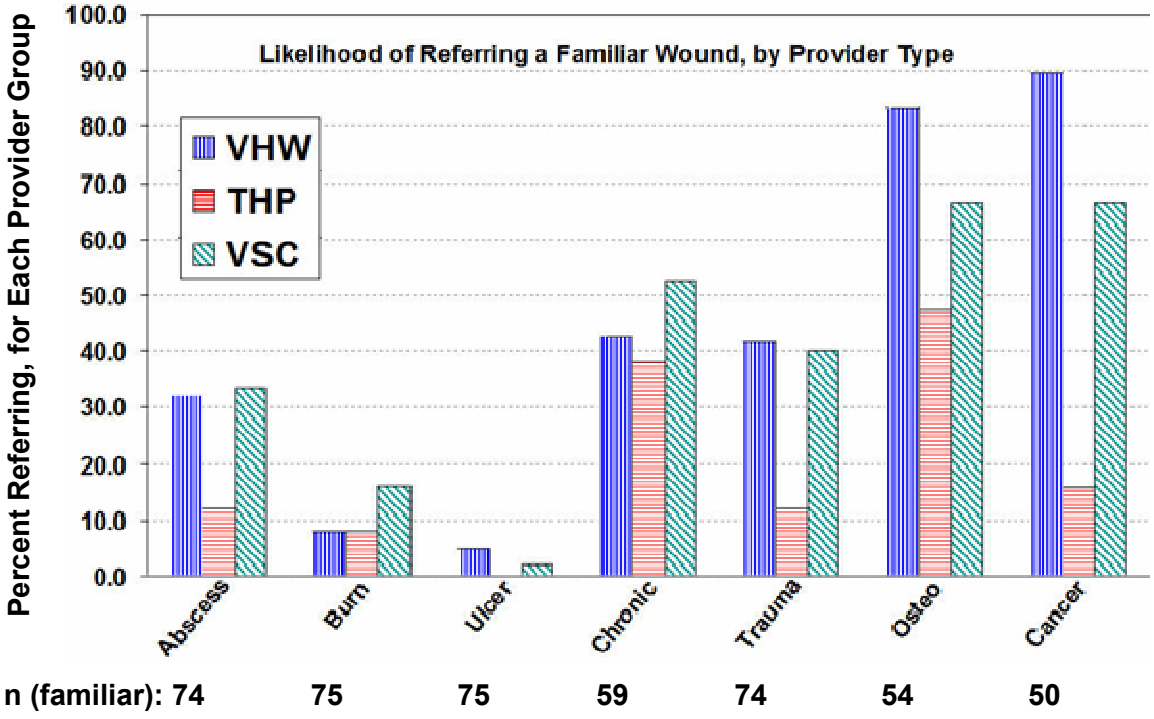
Additional findings

In discussing the trauma wound, half (37) of the participants specifically described a local method of stopping bleeding, including many who would refer the patient to a hospital forthwith. This tendency was distributed evenly among the provider groups. Several plants were said to contain juice which would coagulate blood immediately. A few participants would apply spider webs or human hair to hold clots in place as a means of slowing bleeding. Only one participant (a THP) suggested applying direct pressure on the wound. However, it is possible that this option would have been mentioned more often had the example wound (a puncture with a retained piece of stick) been more amenable to this practice. Three VHWs and four THPS (but no VSCs) also volunteered that the trauma patient would need a tetanus injection.

As the Ghanaian wound experts predicted, most of the villagers were familiar with all seven wound types. As might be expected, the VSCs were least likely of the three provider types to be familiar with the various wound types. When the PI presented the photos and histories of the example patients for the seven wound types to each participant, one, a VSC, did not recognize the abscess wound type. All of the participants recognized the burn and ulcer wounds. Four VHWs, four THPs, and eight VSCs expressed a lack of familiarity with the chronic wound type. One VHW stated he was not familiar with the trauma wound type. Seven VHWs, four THPs, and ten VSCs were not familiar with the osteomyelitis wound type. Six VHWs, six THPs, and thirteen VSCs were unfamiliar with the cancer wound type.

The likelihood of patients with some wound types being referred, rather than being treated in the village, was significantly impacted by provider type. Analyses of variance showed that THPs were less likely to refer patients than VHWs ($p < 0.001$) or VSCs ($p = 0.002$) across all wound types (($\eta_p^2 = 0.210$, a large effect size as defined by Cohen, 1988). When participants who were unfamiliar with the wound type were excluded, Pearson's chi-square was significant for the ulcer ($p = .050$), trauma ($p = .040$), and cancer ($p < .001$) wounds with respect to referring, rather than treating, a familiar wound. Five VHWs, two VSCs, and no THPs would refer the ulcer wound. Several participants who would refer the ulcer wound stated that it could be a Buruli ulcer, which is caused by a mycobacterium and can become a devastating chronic wound without long-term treatment with potent antibiotic. Ten VHWs, ten VSCs, and only three THPs would refer the trauma wound (see Figure 19).

FIGURE 19: PARTICIPANTS WHO WOULD REFER A FAMILIAR WOUND TYPE



The differences between VHWs and THPs with respect to referral were particularly great for the wounds which were most likely to be treated surgically in a hospital setting: the abscess, trauma, osteomyelitis, and cancer wounds. The most dramatic difference in likelihood of referring was with respect to the cancer wound. VHWs and THPs were equally likely to be familiar with this wound type (19 participants in each group). However, only two VHWs would attempt to treat cancer in the village, while only three THPs would not. Four VSCs would treat the cancer wound, while eight would refer the patient. The accessibility of their village did not have a significant impact on a participant's likelihood of referring any wound type.

Summary of Study Results

Participants with a diverse range of wound management knowledge and experience, formal education, and health perspectives from a wide variety of villages in Ghana provided descriptions of their usual wound management methods for a representative range of wound types. Their wound management strategies were often quite similar. While the efficacy of their practices was not assessed, their goals were usually compatible with modern wound management principles. While safe wound cleansing and debridement was not described consistently, most of the providers described moist wound treatments, regardless of the wound type. Most of the participants would cover wounds with either a bandage or an occlusive herbal poultice.

The wound management of the three provider groups differed significantly in only a few areas. At the subcategory level, VHWs were more likely to control

edema/inflammation and to use commercial bandages than either VSCs or THPs. None of the VHWs would use indigenous materials in lieu of outer bandages. THPs were more likely than VSCs to cover wounds with an occlusive herbal poultice or other indigenous materials rather than a bandage. At the domain level, VHWs were significantly more likely than VSCs to dress wounds in a manner congruent with modern wound management principles. VHWs were significantly more likely than VSCs to manage the ulcer and trauma wounds in congruence with modern wound management principles at the domain level.

Participants tended to be familiar with all of the representative wound types. Ecosystem and village accessibility did not seem to influence likelihood of referral to a hospital. THPs were significantly less likely than VHWs and VSCs to refer patients with the ulcer, trauma, and cancer wounds. Half of the participants volunteered a local method of stopping bleeding for the trauma wound, even if they would refer the patient to a hospital.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

This chapter begins with an overview of the research problem and a summary of this pilot study, which begins to address the problem. The major findings of this study are discussed briefly, followed by some observations and insights. The chapter then addresses the study's challenges and limitations. After drawing some conclusions, the chapter ends with specific recommendations for future studies and educational program development to meet the needs of wound patients in rural areas of tropical developing countries.

Overview of the problem

Lack of safe, sustainable, effective wound care is a major health problem in rural areas of tropical developing countries. Although educational programs are currently being developed to teach more effective wound management to health professionals in urban areas of these countries, the rural areas, which tend not to be served by health professionals, pose significant additional challenges.

Summary of the Study

This pilot study introduced an innovative quantitative data collection method: asking participants to complete the stories of actual representative patients who were presented to them visually (with photos) and verbally (the PI recounted their initial histories). This study design successfully overcame many of the cultural obstacles which have prevented researchers from obtaining meaningful quantitative data in the challenging setting of rural areas of tropical developing countries. Seventy-five participants with a wide range of health

perspectives, experience, and wound management knowledge from 25 diverse villages in Ghana provided descriptions of their current usual topical wound management methods for seven representative wound types.

The study design and procedure were informed by modern wound management principles, which served to organize the data. Responses for each participant for each wound type were coded onto a spreadsheet and summarized with respect to congruity with modern wound management principles at the subcategory and domain levels. Descriptions of interventions were summarized by collapsing columns with similar responses. The data was then analyzed with SPSS to answer the four study questions.

Discussion

Major Findings

The literature review suggested that wound care is poor across provider groups in rural areas of tropical developing countries (e.g., Belcher et al., 1977; Gupta et al., 2004; Oluwatsin et al., 2007). While the efficacy of their practices was not assessed, overall participants' goals were compatible with modern wound management principles about two-thirds of the time. Although many participants omitted wound cleansing entirely, several sustainable methods of safe wound cleansing were described. All three provider types described applying crushed fresh green leaves to create a moist adherent poultice, and applying a bandage soaked with a noncytotoxic substance such as salt water. Both of these practices promote autolytic debridement, which is congruent with modern wound management principles. The current usual practices identified in

this study which prove to be affordable and efficacious can be foundational to future wound management protocols.

Regardless of their perspective, health care providers who fail to provide efficacious care may cease to be recognized as experts by their communities. This may explain why few significant differences in the wound management of three provider groups were found. At the subcategory level, VHWs were more likely than either VSCs or THPs to use commercial bandages to control edema and as outer bandages. THPs were more likely than VSCs to cover wounds with an occlusive herbal poultice or other indigenous materials rather than a bandage. At the domain level, VHWs were significantly more likely than VSCs to dress wounds in a manner congruent with modern wound management principles. Summary analyses for each specific wound type showed that VHWs were significantly more likely than VSCs to manage the ulcer and trauma wounds in congruence with modern wound management principles at the domain level. THPs were significantly less likely than VHWs and VSCs to refer patients with the ulcer, trauma, and cancer wounds.

Observations Concerning the Findings

During their initial training the VHWs were exposed to wound care in a clinic setting, which usually includes the use of commercial dressings such as gauze or bandages made from strips of cast-off bed sheets. When they described wound coverings, VHWs consistently mentioned gauze or bed sheet bandages. No VHWs used herbal poultices or other indigenous materials as an outer wound covering for any of the seven wound types. While participants rarely

specifically mentioned edema control in describing this choice, the inelastic nature of these commercial dressings yields significant edema control.

In contrast, the other providers (THPs and VSCs) only sometimes used commercial dressings such as gauze or bed sheet bandages when they covered wounds. THPs and VSCs usually chose to use indigenous materials such as herbal poultices, which provide no edema control, as the outer wound covering. Therefore, one has to wonder if an unintended consequence of the VHWs' health education in clinic settings alone may account for all of the significant differences between provider groups observed for Research Question 2.

Wound-Specific Observations

Only 33 of the participants would treat the chronic wound. To an untrained eye, this superficial wound type could appear to be rather trivial. However, the "story" of the patient included that he had suffered with these wounds for over a year. Many of the participants proclaimed that this patient clearly had been cursed with the wound and must be referred to a powerful shaman. A few who said they would treat the chronic wound justified their decision by stating (as a summary of the history) that the patient had exhausted all other options. One traditional health practitioner asserted that this patient was already dead. Most of the participants who described wound management for the chronic wound recognized that this wound was overly moist. Because the wound was exudating heavily, drying herbal substances were coded as compatible with moist wound healing. None of the participants suggested using petrolatum-based ointments for this wound type, and only four (12.1%) would use an oil-based herbal remedy.

The trauma wound case chosen for the study was so dramatic that it may have altered the results. Half of the participants would render first aid to stop the bleeding, even if they would then transport the patient to the hospital. In order to capture this alternative, a new field was added to the demographic section: bleeding. Of the providers who would treat the wound, several were emphatic that the patient would need a tetanus injection. This is reflected in the demographics with a field: tetanus. A surprising number of participants attributed the trauma wound to supernatural influences.

As the Ghanaian experts predicted, most of the villagers (72%) were familiar with wounds caused by osteomyelitis. Many of them explained that the problem was a piece of bone in the wound which was preventing proper healing and needed to come out. Some referred to “worms” that needed to be driven out. Many said the bone was infected, and some even used the term osteomyelitis. Nineteen participants (25%), including some who recognized that the bone was involved, expressed confidence that they could successfully treat this wound type. Some of the more exotic treatments were reserved for the osteomyelitis wound type, which many participants declared had a supernatural cause.

As was expected, the cancer wound was the least familiar type. Even so, two-thirds of the participants stated that they had seen this type of wound before. Several said, “It looks like cancer.” Some of the THPs were emphatic that they had treated such a wound successfully in the past. These THPs often included magic in their descriptions of cancer wound treatment. Few of the participants who described treatment for the cancer wound discussed how they would

manage the large quantity of malodorous exudate. Although sharp debridement and the use of strong antiseptics would seem to be attractive options for this wound, none of the participants mentioned sharp debridement or antiseptics when discussing the cancer wound. Despite the heavy malodorous exudate described in the case history, no participant mentioned applying drying substances to the cancer wound.

Insights Gained

The study results also confirmed the importance of going to the villages to learn first-hand what is done, rather than relying upon the sampling arriving at clinics. Many of the chronic wounds that the PI managed while working at the Yendi clinic previously had been managed in the villages with methods designed to keep the wound bed dry. This study suggests that dry wound management is not a typical goal of wound care providers in villages, but rather, it is typical of *ineffective* wound management in villages. Patients treated successfully in the villages are unlikely to go to a clinic with chronic wounds. The wound patients the PI treated while at the Yendi clinic were skewed towards those whose previous treatment in their villages had been unsafe or ineffective.

The PI had gone to great lengths to overcome past problems with VHWs going beyond their scope of practice due to a failure to recognize their limitations. It was, therefore, encouraging that so many of the VHWs stated that they would refer the wound types which were most likely to require surgical intervention.

The Obvious Question

Why is the literature on this topic so sparse? The challenges to obtaining

accurate survey date in this environment are certainly a barrier. However, it is clear that the topical management of wounds continues to be overlooked in the developed world as well. Wound care is still not listed as a legitimate medical or nursing specialty on most health provider survey forms. Wounds can be very unpleasant, and topical wound management can be time-consuming, frustrating work. Numbers of wound clinics and wound management specialists are increasing, but there is still no wound specialist credential comparable to that of an anesthetist.

Further, while it is clearly important to treat the whole patient, and not just the hole in the patient, even a casual trip through the literature confirms that international research is focused on systemic solutions to dramatic wounds affecting relatively small populations, such as Leprosy and Buruli Ulcer, to the exclusion of topical solutions to the wound problem in general. WHO (2005, p. 27) contains this perplexing sentence, "Topical cleansing, which was advised 30 years ago, is now considered no more effective than placebo [183]." This statement contradicts wound care guidelines (e.g. Macdonald & Geyer, 2010; Sibbald et al., 2011; Sibbald et al., 2012). The WHO (2005) claim is based upon a Cochrane Review limited to treatment of impetigo (Koning, 2003, 2009, p. 3). Both the original 2003 Cochrane Review and a 2009 update cite a single study in which cleansing was simply not discussed (Dagan & Bar-David, 1992). In this study, a topical antibiotic was more effective than an oral antibiotic (Dagan & Bar-David, 1992). The WHO (2005) statement that topical wound cleansing is not effective was not supported by the evidence provided. However, such statements

from a source as authoritative as the WHO help to explain why current research initiatives concerning wounds in tropical developing countries tend to focus upon systemic antibiotics and epidemiology, rather than topical wound management.

Challenges and Limitations

Most, but certainly not all, of the major limitations of this study revolved around communication barriers. Communication challenges were encountered with all three provider types. Factors in communication problems included the lack of education of many of the participants, cultural norms, the language barrier inherent in working in a nation with as many as 79 distinct tribal languages (Lewis, 2009), and time constraints. Other limitations were due to the small size of the study, and the lack of wound experts in this environment.

Due to the extremely limited vocabularies of the local languages, the precise meaning of some participants' descriptions of wound care was, at times, elusive. While the interpreters sometimes asked participants to repeat their responses using different words, in the final analysis they had to make inferences in distinguishing between various English descriptors. Also, some of the providers were willing to give much more detailed descriptions of their wound management techniques than were others, and some of the interpreters were more skilled at teasing out information from evasive participants (primarily THPs) than others. Although it was clear that most of the participants had no knowledge of microbes, often the words translated "maggots," "worms," "small animals," and perhaps even "tetanus" could have instead been translated "germs" or "contaminants." Conclusions had to be drawn in coding the data, as well.

Although the researcher attempted to code the wound management methods described uniformly, bias could have entered into the process.

Significant communication in villages traditionally takes place in a group setting over a long period of time. Because study design required the PI to speak to only one participant at a time and the research team was able to spend only a few hours in each village, only limited clarity could be obtained. For example, burned cotton cloth yielded ashes with medicinal properties for several participants. The fact that the cloth was plain white cotton was important to the participants, but the rationale (physical or spiritual) escaped the PI. While ensuring privacy would certainly have led to some individuals being too uncomfortable to participate in the study, it is also possible that would also have resulted in different responses. Using a focus group methodology would have been more in keeping with cultural norms, but is unlikely to have produced more accurate answers.

Some of the VHWs stated that the reason they underwent the health care training was to decrease the number of people in their villages who were injured from dangerous traditional wound management practices, such as pouring boiling water on wounds, which enlarges them (Oluwatosin, 2007). This study was not designed to reveal subtle but critical distinctions between harmful and helpful practices, such as how hot the water used for cleansing was or how toxic or soothing the herbal remedy was. While the participants did occasionally volunteer that the water they used was cooled before cleansing, the PI avoided asking many clarification questions due to the risk of inadvertently guiding the

participant to a response that did not reflect their actual practice. Instead, the PI accepted that if the participant believed their wound management kept the wound moist, or that the herbal remedy was soothing rather than caustic, this was in fact the case. If a participant stated that a wound treatment was wet, the PI coded the intervention as moist wound healing, even if no method for preventing the wound from drying out was articulated. After trust is engendered through the interview process, it would often be possible to gain permission to observe one or two of a participant's dressing changes. The observations could augment the descriptions of wound management provided by the participants in the interviews.

Another study limitation related to communication was that if a participant did not recognize the significance of an intervention, it was unlikely to be included in the description of wound management, even if it completely changed the character of the treatment overall. This became evident when one THP brought two of his wound patients to the interview location so that the PI could see his work first-hand. When he removed the bed sheet bandages, the PI was startled to see that the THP had used a piece of black plastic from a bag to keep the herbs he was using to treat the wound from leaking out from under the bandages. He had not mentioned the plastic in the interview. The plastic bag served as an occlusive dressing, keeping the herbs moist. Although the plastic played a critical role from a scientific standpoint, it was clearly not a significant aspect of wound management to the THP. This particular communication gap did not affect the study results, because whenever a participant described his wound management as moist, it was coded as such, regardless of how implausible that

conclusion was. Nonetheless, the incident served as a reminder that verbal communication rarely captures the full scope of any activity.

So many of the demographic data points were obtained by estimating that the PI did not feel it was appropriate to run statistical analyses on the numbers. Questions about village populations and the number of wounds participants managed in a month were so difficult for most of the participants to answer that they were omitted from the study completely. Although it is likely that these are also educated guesses, it might have been possible to gain population data from census statistics. Future researchers may identify a way to determine how many wound patients a given participant manages with some degree of accuracy.

This pilot study took place within only one country, and the 75 participants represented only 25 villages. While the diversity of the ecosystems and accessibility of the included villages helped to ensure that the study adequately represents the usual wound management practices throughout Ghana, it is possible that other usual practices would be described in other West African countries, and it is quite likely that other practices would be described by indigenous rural wound care providers in other tropical developing countries, particularly those in East Africa, Southeast Asia and the tropical island nations.

Another limitation of this study is that only the PI rendered the descriptions from the participants on the recorded interviews into coded data and assessed the congruence of the responses. Other wound experts who could interpret the Ghanaian English recordings were not available for this project. Opportunities for

bias would have been decreased if at least one additional wound care expert had verified these procedures.

Conclusions

A critical question this study helps to answer is, “Do modern wound management principles even apply in this setting?” Although studies in temperate climates (see Hutchinson & McGuckin, 1990) show that dry wounds are more likely to become infected than moist wounds, could it be that the incubator-like conditions of the tropics are so hospitable to microbes that modern moist wound management is ineffective or unsafe in this environment? While these conditions do demand excellent wound bed preparation techniques to remove the infectious organisms that will inevitably quickly colonize every wound bed, it was very reassuring to learn that most of the participants, whose knowledge was often based upon generations of experience, believed moist methods were effective for managing wounds in tropical villages. The PI’s experience successfully applying moist wound management methods for five years in Yendi supports the use of modern wound management principles in this setting as well.

Well-designed basic research studies are needed in the field of wound management. This pilot study was the first step towards addressing the lack of published usual practice data, which is needed to design comparison trials of proposed and current usual wound management practices. These studies are needed to reach the goal of developing and disseminating evidence-based, attainable solutions to wound management problems for nonprofessional health care providers in rural areas of tropical developing countries.

The similarities in the wound management strategies of the three provider groups across the four ecosystems of Ghana in 25 villages with varying degrees of accessibility were more striking than the differences. This provides evidence that wound management strategies based upon the descriptions from this study and other similar studies can be acceptable to the full range of nonprofessional health care providers found in rural areas of tropical developing countries.

Future Directions

This study's design template can easily be adapted to the cultures of other tropical developing countries. The indigenous methods of wound management discovered in this study should be added to those found in other tropical regions of the world, such as East Africa and Southeast Asia, to expand the database of wound management descriptions. Indigenous wound care providers from various parts of the world can benefit from sharing their knowledge of herbal remedies. For example, aloes are commonly used as a moist wound dressing in other parts of the world and are found in Ghana, but they were not mentioned by any of the study participants, even though the PI included aloe in the village health worker course. In contrast, many study participants described using *Acheampong*, a plant imported to Ghana from South America in the 1970's, for wounds.

The data from this descriptive study and others based upon this template can be utilized to develop experimental studies comparing the most promising identified usual practices of indigenous wound care providers with proposed affordable introduced interventions based upon modern wound management principles. Such studies would definitively answer the question about whether or

not these principles are applicable to the setting of rural areas of tropical developing countries. In order to ensure ecological validity, the actual wound care in these studies is best performed by nonprofessional health providers in rural tropical villages. The results of these studies can be individualized to guide the development of wound management protocols for educational programs for nonprofessional health providers in each of the targeted tropical developing countries. Ineffective or harmful current practices can be more successfully replaced by introducing safer and more efficacious practices in culturally acceptable terms, emphasizing superficial similarities between the familiar practice and the proposed innovation.

Some specific indigenous remedies warrant special attention. Is the finely ground white powder from the burnt shell of the black snail efficacious in deflating burn blisters? Does this powder have anti-inflammatory properties? Is sasa (the boiled fibers from a plantain stalk) a suitable substitute for cotton wool when cleansing wounds? Some of these questions can be addressed in laboratory studies, while others will require additional field studies.

The systematic study of wound management in rural areas of tropical developing countries has just begun. Information from each new well-designed study can be added to the growing body of knowledge in this new field. Such studies will make it possible to create evidence-based educational programs which will make a difference in the lives of villagers suffering from inadequately managed wounds.

APPENDIX A: OUTLINE OF DEPENDENT VARIABLES

Final Summarized Categories for Topical Wound Management Findings

Data Variables: 1 = Participant included this practice in describing their management of this wound type
0 = Participant did not include this practice in describing their management of this wound type

Summary Variables: 1 = Response meets modern wound management criteria
0 = Response does not meet modern wound management criteria

Wound Response Variables (Actual variables imported into SPSS are in bold type):

Fam = Familiar with Wound Type?
0 = Participant was not familiar with this wound type and would not treat it
1 = Participant was familiar with this wound type and would refer forthwith (no treatment was described by this provider for this wound type)
2 = Participant was familiar with this wound type and described treatment

A prefix at the beginning of each variable (**Abscess, Burn, Ulcer, Chronic. Trauma, Osteo,** or **Cancer**) indicates which wound type was being discussed.

Prep I. Wound bed preparation (preparing the wound bed for healing by secondary intention)
Goal: remove debris, germs, and nonviable tissue from the wound bed with minimal trauma
Clns A. Wound/periwound cleansing
1. Meets modern wound management criteria:
IA1a. wash thoroughly with clean water, saline, fresh breast milk, or fresh coconut milk
IA1b. wash thoroughly with diluted: EUSOL or Dettol or hydrogen peroxide, soap and clean water salt solution, ocean water (for dirty wounds only)
IA1c. wash thoroughly with herbs and/or roots soaked in clean water and/or boiled plantain stalk (*sasa*)
2. Does not meet modern wound management criteria:
IA2a. no wound bed cleansing
IA2b. wash with a cytotoxic substance such as full-strength EUSOL, Dettol, hydrogen peroxide, betadine, salt-petre, lime juice, mentholated spirit (alcohol), akpeteshie
Dbrd B. Debridement (if nonviable tissue is present)
1. Meets modern wound management criteria:
IB1a. cleanses “very well”
IB1b. conservative sharp debridement, incise (if needed); drain purulent areas such as abscesses and infected burn blisters
IB1c. papaya, sugar, or similar, frequently checked so that only dead tissue is removed

IB1d. autolytic debridement with occlusive dressings to keep wound bed clean and moist or use a poultice or dithranol to draw out the purulent drainage, stick, or "bad blood"

2. Does not meet modern wound management criteria:

IB2a. no debridement of significant necrotic tissue or debris, such as the stick (trauma)

IB2b. traumatize the wound: papaya or similar, infrequently checked so that live tissue is removed, or repeatedly burn trauma wound with Acheampong leaf placed on hot stone (to kill tetanus) or deroof uninfected burn blisters

Trtmnt II. Wound bed treatments (substances applied directly to the wound bed or over the dressing)

Goals: keep wound bed clean and moist, promote autolytic debridement, avoid injuring new cells, decrease inflammation and edema/lymphedema

Tpcl A. Applied directly to the wound bed to keep it moist and uninfected

1. Meets modern moist wound healing (end result must be at least semi-occlusive)

a. clean non-cytotoxic substances which allow the wound bed to stay moist

IIA1a1. processed (clean) shea butter, oils, or fats

IIA1a2. clean organic matter (egg, plant parts or mixtures, clean clay or dirt)

b. commercial products

IIA1b1. petrolatum or antibiotic ointments (commercial, or capsules in oil) applied thickly

IIA1b2. saline-soaked gauze or cloths, or sutured trauma wound

IIA1b3. povidone iodine-soaked gauze, *diluted* antiseptic-soaked gauze for dirty wounds

2. Does not meet modern moist wound healing

IIA2a. substances that breed infection (excrement, parts of dead animals), or ashes, misc. powders, or ground-up organic matter to overly dry open wounds

IIA2b. cytotoxic substances (full-strength commercial antiseptics, dry antibiotic powder applied into a not overly wet wound bed, or tree bark that burns like pepper)

Edma B. Applied directly to wound bed or over dressing to decrease or prevent inflammation or edema

1. Meets modern moist wound healing

IIB1a. anti-inflammatory moist products applied to wound bed, or powders to deflate blisters

IIB1b. limb elevation, appropriately applied wraps, application of cold (or heat, for abscess)

2. Does not meet modern moist wound healing

IIB2a. no treatment for significant edema/lymphedema

IIB2b. constrictive wraps, heat-producing or "burning" substances without close monitoring, or drying products (including snail shell powder) applied in the open wound bed

Drsg III. Wound dressings (covers, secondary dressings)

Goals: keep wounds clean, avoid injuring cells, promote appropriate moisture balance

Cmrcl A. commercial products
1. Meets modern moist wound healing (will be at least somewhat non-adherent)
IIIA1. clean cloths, plasters, or gauze if wound bed is kept moist and they are soaked off
2. Does not meet modern moist wound healing (will adhere to the wound bed)
IIIA2a. dry gauze, petrolatum gauze, or permeable cloth that is removed dry (tearing)
IIIA2b. left open to air (no cover)

Indg B. indigenous products
1. Meets modern moist wound healing (will be at least somewhat non-adherent)
IIIB1a. concoctions which form a non-adherent moisture-proof barrier when they dry, or cover with plantain, banana leaves or other relatively impermeable leaves
IIIB1b. oil-based concoctions applied thickly
IIIB2. Does not meet modern moist wound healing (will adhere to the wound bed) powdered leaves or other dry materials packed into the wound bed

Demographics variables:

EcoSys = ecosystem of village
1: Grassland Savannah
2: Semi-deciduous Rainforest
3: Transition/Coastal Savannah
4: Tropical Rainforest

Access = accessibility of village
0 inaccessible by any motor vehicles at least once in a typical year (low-water crossings)
1 accessible only by 4-wheel-drive motor vehicles, or more than 2 hours from hospital during some times of year (most dust roads)
2 accessible by ordinary taxis all year and less than two hours' drive to hospital (improved road)

Gender 1 = Male 2 = Female

Age = approximate age (if participant could not state age, it was extrapolated from known age at key events)

Parent 0 = Has never parented a child 1 = Has parented at least one child

YrsExp = years of experience managing wounds (subtract age when they began from current age)

PerMo = participant's estimated number of discrete wounds managed in a typical month

Training = approximate number of weeks of formal training in wound care
0 = no training (or learned from dwarves, dreams, or other supernatural source)
1 = only 4 – 8 weeks of formal training
2 = additional formal training
3 = several years of apprenticeship without any formal training
4 = formal training plus years of apprenticeship

YrsEd = approximate number of years of formal education

Tetanus = volunteers that patient needs a tetanus shot (burn or puncture wound): 0 = did not, 1 = did

Bleeding = volunteers a method to halt bleeding (trauma wound): 0 = did not, 1 = did

Initial (Expected) Categories for Topical Wound Management Findings

(The table and corresponding spreadsheet were modified as the data was coded so that the final products reflected the participants' actual responses, in contrast to the expected responses. The columns on the final spreadsheet were then collapsed to facilitate the summarization of the data, with the edited table reflecting the new combined entries.)

I. Wound bed preparation (preparing the wound bed for healing by secondary intention)
Goal: remove debris, germs, and nonviable tissue from the wound bed with minimal trauma
A. Wound/periwound cleansing:
1. Meets modern wound management criteria:
a. wash thoroughly with water from a borehole or other uncontaminated source
b. wash thoroughly with water from a clear running stream
c. wash thoroughly with commercially prepared saline
d. wash thoroughly with soap and clean water
e. wash thoroughly with home-made saline
f. wash thoroughly with strong salt solution (appropriate for dirty wounds only)
g. wash thoroughly with fresh breast milk
h. wash thoroughly with other clean solution (e.g., fresh coconut milk)
2. Does not meet modern wound management criteria:
a. no wound bed cleansing
b. wash with water from a dam (artificial lake) or slow-moving river
c. wash with another contaminated liquid
d. rinse in kerosene, Detol, EUSOL, alcohol, or another cytotoxic product
e. wash only superficially, no assessment to ensure desired result (clean wound bed)
B. Debridement (if nonviable tissue is present)
1. Meets modern wound management criteria:
a. scrub until bleeding tissue is reached
b. conservative sharp debridement to remove non-viable tissue/epibole
c. papaya or similar, frequently checked so that only dead tissue is removed
d. autolytic debridement with occlusive dressings to keep wound bed clean and moist
e. frequently monitored maggots
f. incise and drain purulent areas such as abscesses and infected burn blisters
2. Does not meet modern wound management criteria:
a. no debridement of significant necrotic tissue
b. inappropriate sharp debridement (viable tissue removed or necrosis remains)
c. papaya or similar, infrequently checked so that live tissue is removed
d. application of cytotoxic topical products such as EUSOL, petrol, or diesel

e. maggots not frequently monitored
f. deroof uninfected burn blisters

II. Wound bed treatments (substances applied directly to the wound bed or over the dressing)

Goals: keep wound bed clean and moist, promote autolytic debridement, avoid injuring new cells, decrease inflammation and edema/lymphedema

A. Applied directly to the wound bed to keep it moist and uninfected

1. Meets modern moist wound healing (must add an occlusive secondary dressing)
    a. moist clean non-cytotoxic substances
        1. processed (clean) shea butter
        2. thick honey (honey which does not grow mold),
        3. fresh cut open aloe or other gelatinous plant flesh
        4. clean nontoxic (cooking) oils, including python fat if fresh
        5. fresh egg yolk
        6. local plant-based pastes intended to keep the wound clean and moist
        7. petrolatum jelly
    b. commercial antibiotic ointments
    c. clay
    d. powders intended to absorb excess exudate (only in very wet wounds checked often)
        1. ground leaves, if the wound is moist enough to prevent desiccation
        2. sugar, if the wound is moist enough to prevent desiccation
    e. lint intended to absorb excess exudate (not to dry the wound)
2. Does not meet modern moist wound healing
    a. cytotoxic substances
        1. EUSOL
        2. petrol
        3. diesel
        4. used motor oil
        5. kerosene
    b. substances that provide a breeding ground for infection
        1. excrement
        2. watered-down honey,
    c. powders intended to dry up the wound
        1. ashes
        2. ground leaves
        3. sand
        4. salt
        5. burnt ground black snail shell
    d. commercial antiseptics or antibiotics applied into a wound bed (not on intact skin)
        1. ichthammol
        2. GV paint
        3. antibiotic powders

B. Applied directly to the wound bed or over the dressing to decrease or prevent inflammation or edema

1. Meets modern moist wound healing

a. anti-inflammatory moist products applied in the wound bed
b. limb elevation
c. appropriately applied wraps which do not lead to further injury (figure 8, etc.)
d. application of cold

2. Does not meet modern moist wound healing
a. anti-inflammatory products drying products applied in the wound bed
b. no treatment for significant edema/lymphedema
c. constrictive wraps which risk further injury (patients not taught precautions)
d. application of heat-producing substances without frequent monitoring

III. Wound dressings (covers, secondary dressings)

Goals: keep wounds clean, avoid injuring cells, promote appropriate moisture balance

A. commercial products

1. Meets modern moist wound healing (will be at least somewhat non-adherent)
a. foam rubber (furniture foam)
b. plastic (e.g.., from bags)
c. clean cloths if kept moist
d. plasters (bandaids) if edges are sealed to retain moisture
e. packaged modern moist wound dressings such as foams, hydrogels, films…

2. Does not meet modern moist wound healing (will adhere to the wound bed)
a. dry gauze
b. petrolatum gauze (studies show it permits the wound bed to dry out)
c. permeable cloth that is permitted to dry (simply protects from flies and other insects)
d. plasters which allow air to enter the wound so that it scabs
e. left open to air (no cover)

B. indigenous products

1. Meets modern moist wound healing (will be at least somewhat non-adherent)
a. banana leaves
b. other relatively impermeable leaves that do not decay or irritate the wound bed
c. concoctions which form a non-adherent moisture-proof barrier when they dry

2. Does not meet modern moist wound healing (will adhere to the wound bed)
a. powdered leaves or other dry materials packed into the wound bed
b. leaves which irritate the wound bed or permit the wound bed to become desiccated

Demographics Codebook:

Participant Demographics

ProvType = Provider Type
1 Village Health Worker
2 Traditional Health Provider
3 Villager Self-Care
GENDER
1 Male
2 Female
AGE = approximate age
PARENT
0 = Has never parented a child
1 = Has parented at least one child
YRSEXP = years of experience managing wounds
PERMO = estimated number of discrete wounds managed in a typical month
WKSTRN = approximate number of weeks of formal training in wound care
YRSED = approximate number of years of formal education

Village Demographics
ECOSYS = ecosystem of village
1 = Grassland Savannah
2 = Forest Savannah
3 = Coastal Savannah
4 = Tropical Rainforest
HHS = estimated number of households
POP = estimated total population
ACCESS
0 inaccessible by any motor vehicles (including motorcycles) during some times of year
1 inaccessible by 4-wheeled motor vehicles during some times of year (motorcycle only)
2 accessible by 4-wheeled motor vehicles all year

Variables for each wound type:
Fam = Familiar with Wound Type?
0 not familiar with wound type
1 familiar with wound type

ProvType = Provider Type
1 Village Health Worker
2 Traditional Health Provider
3 Villager Self-Care

APPENDIX B: POPULATION CALCULATIONS FOR 36 TARGETED COUNTRIES

Some or all of the landmass of 35 of the 40 countries in the World Bank's lowest income bracket ($995 or less per capita as of June 2011 is in the tropics (World bank, 2011). These are the countries further research will target (see table below) The status of these countries as under-developed is confirmed by data from the UN, which ranks all of them in or near the bottom quarter of all UN member countries on their Human Development Index of 2011. Population statistics are from Central Intelligence Agency, 2012.

South Sudan (not yet included in the lists because it gained independence in 2012) was added because it meets the income and geographic criteria to be included in the studies, yielding a total of 36 targeted countries.

Country	Population	Rural population
Bangladesh	161,083,804	115980338.88
Benin	9,598,787	5567296.46
Burkina Faso	17,275,115	12783585.1
Burma	54,584,650	36025869
Burundi	10,557,259	9395960.51
Cambodia	14,952,665	11962132
Central African Republic	5,057,208	3084896.88
Chad	10,975,648	7902466.56
Comoros	737,284	530844.48
Dem. Rep Congo	73,599,190	47839473.5
Eritrea	6,086,495	4747466.1
Ethiopia	91,195,675	75692410.25
The Gambia	1,840,454	772990.68
Ghana	24,652,402	12079676.98
Guinea	10,884,958	7075222.7
Guinea-Bisau	1,628,603	1140022.1
Haiti	9,801,664	4704798.72
Kenya	43,013,341	33550405.98
Laos	6,586,266	4412798.22
Liberia	3,887,886	2021700.72
Madagascar	22,005,222	15403655.4
Malawi	16,323,044	13058435.2
Mali	15,494,466	9916458.24
Mauritania	3,359,185	1981919.15
Mozambique	23,515,934	14579879.08
Niger	16,344,687	13566090.21
Rwanda	11,689,696	9468653.76
Sierra Leone	5,485,998	3401318.76
Solomon Islands	584,578	473508.18
Somalia	10,085,638	6353951.94
South Sudan	10,625,176	8287637.28
Tanzania	46,912,768	34715448.32
Togo	6,961,049	3967797.93
Uganda	33,640,833	29267524.71
Zambia	13,817,479	8843186.56
Zimbabwe	12,619,600	7907480
Totals	807,464,707	578,463,300

APPENDIX C: THE SEVEN WOUND EXEMPLARS

Wound A:

A young man has come to you with a painful, very swollen hand. The problem began a few days ago, but it is getting worse. He has not treated it in any way. He can no longer farm because of the pain and swelling. The young man does not remember anything that may have caused the problem – he says, "It came on its own."

Wound B:

A small child walked into a burn pit that still had hot items in it under the ashes and burned his feet a few days ago. The child refuses to walk and cries all the time, so the mother is bringing the child to you for help. The larger blisters have been burst, but there are a few small intact blisters on the toes of the right foot.

Wound C:

A school child developed a leg ulcer that is so painful that it is becoming difficult to walk. The wound is producing small amounts of thick yellow foul-smelling drainage. The child does not remember how long ago the ulcer came.

Wound D:

These wounds have been a problem for the patient for more than one year. The patient has tried many remedies, but none have led to long-term improvement. The wound is very painful. A relative recommended that he come to you for healing

Wound E:

A farmer was working his field when he stepped on a sharp stick. The stick went completely through his foot and caused a lot of bleeding. He wrapped his foot in a cloth and immediately bicycled to you for help.

Wound F:

The skin over a broken bone has healed, but a small wound with thick foul-smelling yellow drainage keeps appearing at the site of the scar.

Wound G:

The patient has a non-healing wound that is only a little painful. There is a large amount of over-growth of tissue at the site, and more comes every day. The scent is very terrible.

APPENDIX D: LETTER TO POTENTIAL VHW PARTICIPANTS

17 April 2012

Dear PHCW,

Greetings from Texas! I pray that this letter has arrived quickly and that you and your family are well.

Our family and I worked with the Church of Christ Mission Clinic in Yendi from the beginning of November in 1999 to the end of October in 2004 (five years). During this time we were blessed to meet and teach many PHCWs. Brother Richard and I hope to return to Ghana in August, September and October to visit with you and other PHCWs as I gather data for a research study about health care in villages of West Africa.

I am writing because I would like to communicate again with everyone who was taught through the Church of Christ Mission Clinics' Primary Health Care Worker Program between 1985 and 2011. I am using the most recent address I have for each PHCW graduate, which may be out of date. **Please pass this along to others.**

I understand that there have been many changes in health care, transportation, government, and communication since I was last in Ghana in 2006. Also, you may no longer be interested in health care, or you may no longer live in a village. It would be very helpful to me if I could update the records for the PHCW program.

Please contact me **as soon as possible** (you may write on the back of this letter) with the following information:

The name you used when you took the PHCW course and the name you prefer to be called

Your best mailing address.
Where you live, including the part of the village (if it is large), the village, subdistrict, district, region, and state.

Detailed directions for driving to your home from the nearest city, with the GPS location if you have it (some cell phones offer this information).

An email address and/or cell phone number I can use to reach you (if I need to reach you through a friend or relative, please tell me their name also).

What health care work are you still doing? (**circle all** that describe what you do) advise people, sell medicines, work with a group, help your family make healthy choices, help

church members with illness, run a health post, work at a health post someone else runs, wound care, teach small groups, other (write on the back of this letter).

The best way to reach me is by email at lindabenskin@utexas.edu or you can send the information by post.

I will have a new phone number when I am in Ghana which will allow me to text with you quickly and easily, but I will be working a lot, so I cannot answer every text. You may be able to text me now at 001 512 659 0812 but if I do not reply in 24 hours, this means I did not get your text. If you leave me a voicemail at that same number (001 512 659 0812) please speak very slowly and clearly. I am also on Facebook and Google Plus.

Thank you in advance for your information.

Blessings,

Linda Benskin (Sister Linda)
11304 Prairie Dog Trail
Austin, TX 78750 USA

APPENDIX E: EXPLANATION OF STUDY AND VERBAL CONSENT REQUEST

Verbal Consent Script:

Many people around the world are concerned about wound care right now. Very few people are good at managing wounds. The health professionals: the doctors and nurses, and the traditional healers in the villages all need to learn from one another so that we can do a better job of helping people with wounds. The purpose of the talks I am having with you today and with other people is to find out from different people in villages what they do for wounds, so that other people around the world can learn from one another what usually happens with wounds in villages. You were chosen to be included in this study because you know something about taking care of wounds that might help people in places far away do a better job of taking care of wounds.

I will record what we say to one another so that I can add our talk to what people in other villages say they do for wounds. The recordings will only be used to gather up the wound care ideas that you and the other people have shared with me. No one but myself and my assistant will be able to listen to the recordings. Your answers will be mixed together on a paper with everyone else's to make a big picture, the way the many strands of grass make a roof. The paper with everyone's ideas mixed together will be used to plan better wound care. Our talk will take about as long as it takes to prepare a meal.

I plan to show and tell you about the wounds of seven patients, one at a time. I will ask you, "What is the *main* thing you would do for this wound patient?" Then I will ask you to tell me all the things you would do before and after this main thing, until you have told me everything you would do. I will keep asking you to tell me what you would do before and what you would do after, *even if there is nothing more that you could or should do*, to be sure that we do not leave anything out of the story of what you would do. I will do this for each of the wound patients, one at a time. I do not want you to tell me everything you might *possibly* do – what I am trying to learn is the story of what you would do most often, or usually, for each of the seven wound patients.

I would also like for you to help me understand how you make choices for taking care of wounds. For this reason, I will ask you to tell me the purpose of the things you do for wound care. I am not questioning whether or not what you are doing is right, and I understand that it is not always possible to say the purpose of every thing. I am asking because I want to learn from you what you hope to find that lets you know the wound is doing well, and what your goals are along the way, as you take care of wounds.

If you do not want to answer my questions, or if you want to stop at any time, you may tell me so. Nothing bad will happen to you if you do not talk with me, or if you decide to stop talking to me.

Request for Verbal Consent:

Do you understand the purpose of my talk with you?

Do you have any questions?

Are you willing to talk with me about the wound care you do?

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VITA

Linda L. L. Benskin was born in 1959. She married Richard Benskin in 1978. She specialized in pediatrics at an Austin hospital as a young BSN, advancing to the position of night charge nurse. In 1989, Mrs. Benskin began caring for ventilator-dependent children as a home health nurse to make time for home schooling her two children.

Linda Benskin moved with her family to work with a Christian clinic in the remote northern town of Yendi, Ghana, West Africa from 1999 to 2004. From there, she directed a nationwide village health worker training program, creating an entirely new curriculum in tandem with producing a textbook for teaching basic health skills to villagers with a minimal degree of literacy in developing nations. She was the interim director of the Christian clinic her final year in Ghana, facilitating the successful transition to a 100% Ghanaian run, self supported operation. She documented case studies during this time.

Upon her return to the USA, Linda Benskin became certified as a wound expert, presenting posters and working for Ferris Mfg. Corp as a Clinical Support Specialist and the coordinator of their independent clinicians' poster initiative from 2005 to 2009. In 2009, Mrs. Benskin entered UTMB's BSN-to-PhD program in Nursing Education.

Mrs. Benskin has been an invited speaker at the International Health Care Foundation's Medical Missions Seminar on five occasions (for Nursing CEUs). In 2010, she produced a complete Skin & Wound Care module for UTMB's BSN Adult I course.

Education, Licensures and Certifications

1982 BSN Bachelor of Science in Nursing, University of Texas at Austin
1983 RN Registered Nurse, State of Texas
2001 SRN State Registered Nurse, Ghana, West Africa
2006 CWCN Certified Wound Care Nurse, Wound Ostomy Continence Nursing Certification Board
2007 CWS Certified Wound Specialist, American Board of Wound Management
2013 PhD University of Texas Medical Branch, Galveston, Texas

Selected Publications

1981 Analytical Reasoning (a chapter in the LSAT Weekend Review student manual)
1983 NCLEX-RN review course & materials for UT Austin School of Nursing
2003 Handbook for Health Care in Developing Countries (~300p. textbook for VHWs)
2005 – 2012 Approximately 30 unique posters presented at conferences worldwide
2007 – 2009 Four clinical education monographs published by Ferris Mfg. Corp.
2012 PolyMem® Wic® Silver® Rope: A Multifunctional Dressing for Decreasing Pain, Swelling, and Inflammation. *Advances in Wound Care*
2012 A Concept Development of the Village Health Worker. *Nursing Forum*

Selected Awards

2006 1st place Wound, Ostomy, Continence Nurses Society Case Study Merit Award
2008 Educator of the Year, South Central Region Wound, Ostomy, Continence Nurses
2009 2nd place Clinical Poster Award at International Global Health Week, UTMB
2010 Hector P. Garcia, M.D. Cultural Competence Award
2011 UTMB 7th Annual InSIGHT Photo Contest 1st place Award, Community Category

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This dissertation was typed by the author, Linda L. L. Benskin.