CLINICAL MANAGEMENT extra

A Framework to Assist Providers in the Management of Patients with Chronic, Nonhealing Wounds

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Raelina S. Howell, MD • Clinical Research Fellow • NYU Winthrop Hospital • Mineola, New York

Scott Gorenstein, MD, FACEP • Clinical Director • Division of Regenerative Medicine • NYU Winthrop Hospital • Mineola, New York

Brian M. Gillette, PhD • Research Scientist • NYU Winthrop Hospital • Mineola, New York

Julie DiGregorio, CCRP • Senior Research Manager • Department of Internal Medicine • Northwell Health • Great Neck, New York

Theresa Criscitelli, EdD, RN, CNOR • Assistant Vice President • Perioperative and Procedural Services • NYU Winthrop Hospital • Mineola, New York

Matthew Sontag Davitz, BS • Medical Student • NYU Winthrop Hospital • Mineola, New York

Jon S. Woods, MD • Clinical Research Fellow • NYU Winthrop Hospital • Mineola, New York

Michael Acerra, BA • Data Coordinator • NYU Winthrop Hospital • Mineola, New York

Harold Brem, MD, FACS • Chief • Division of Wound Healing and Regenerative Medicine • Newark Beth Israel Medical Center • Newark, New Jersey

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GENERAL PURPOSE:

To describe the development of an evidence-based wound electronic medical record (WEMR) framework for providers to execute timely, protocol-based, best-practice care for patients with chronic, nonhealing wounds.

TARGET AUDIENCE:

This continuing education activity is intended for physicians, physician assistants, nurse practitioners, and nurses with an interest in skin and wound care.

LEARNING OBJECTIVES/OUTCOMES:

After completing this continuing education activity, you should be better able to:

1. Summarize the development of a WEMR framework to enhance best-practice care of chronic wounds for both patients and providers.

2. Distinguish the clinical parameters known to delay wound healing and the evidence-based recommendations that informed the framework.

ABSTRACT

The care of patients with nonhealing wounds involves a host of treatment modalities. The authors developed a wound-specific framework to enhance provider management of these wounds and a summary sheet to involve patients and caregivers in their own healthcare to improve treatment adherence and outcomes. Implementing evidence-based practice for chronic wounds enables corrective actions to optimize care.

KEYWORDS: CARE Act, chronic wound, electonic medical record, evidence-based care, framework, nonhealing wounds, wound electronic medical record

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INTRODUCTION

Multiple factors are known to impact wound healing, such as glycemic control, nutrition status, pain, acute and chronic renal insufficiency, body mass index, hypo- or hyperthyroidism, systemic atherosclerotic disease, anemia, smoking, mobility status, inflammatory state, and psychological well-being.[1–9] Therefore, the management of a patient with a chronic, nonhealing wound requires the provider to coordinate care not only for the wound, but also for the patient's comorbidities. However, performing a continuous, real-time review and optimization of every medical and social etiology of chronic, nonhealing wounds is a daunting task for providers. In addition, the patient's ability to adhere to their management plan can be challenged if he/she has a limited understanding of his/her diagnosis and treatment goal.

To assist providers in tracking these numerous variables, wound electronic medical record (WEMR) databases have been developed and modified over the years as a tool to collate the key information used during wound treatment.[10–15] Multiple aspects of wound care such as wound characteristics, outpatient appointments, and treatment plans can be entered into a WEMR, aiding with care protocols and communicating wound status and treatment plans to patients and caregivers. This report describes the development of an evidence-based WEMR framework for providers to execute timely, protocol-based, best-practice care for patients with chronic, nonhealing wounds.

Further, the WEMR framework can generate a single-sheet data report including wound photographs and diagnosis and treatment summaries that can be provided to each patient and his/her family during his/her weekly clinic visit. This sheet facilitates discussion between the patient and provider regarding diagnoses, test results, and management options. The act of giving the patient and caregiver a WEMR sheet enables the patient to visually follow the progression of his/her wound and test results, helping to facilitate a better understanding of diagnoses and increase adherence to the treatment plan.

Including patients and caregivers in their own care is essential to overall patient care as evidenced by the recent Caregiver Advise, Record, Enable (CARE) Act,[16] which advocates for inclusion of the patient and caregiver to facilitate safer care upon discharge. By highlighting variables on the WEMR sheet that need to be monitored and providing corrective actions for each variable, the provider and patient can identify specific areas to modify that may have been overlooked or lost to follow-up.

The goal of this study was to develop an evidence-based wound framework for both patients and providers to enhance best-practice care of chronic wounds. Development of the framework was based on a combination of clinical information from patients seen at a tertiary-care facility and a literature search. Subsequent use of this work will result in improved wound healing and decreased healthcare costs.

METHODS

This study was designed to develop a wound-specific framework using data from real-world patients. Any patient 18 years or older with a nonhealing wound seen by the wound service at NYU Winthrop Hospital was included in this institutional review board–approved study after obtaining informed consent. Standard

guidelines[12,17–24] and protocols[11,25,26] were followed for all patient treatments. Deidentified medical information for each patient was entered into a web-based Health Insurance Portability and Accountability Act–compliant database that was created and maintained by Target Health, Inc.

The clinical information for 189 patients with 546 wounds was collected from December 2013 to March 2017, including demographics, vital signs, laboratory results, wound photographs, and imaging studies, and entered into the database on a weekly basis. The data were continuously entered until each patient's wound closure, loss to follow-up, or death. This information was tabulated into a framework for providers to use for patient management. The database was then programmed to generate a concise, single-page summary sheet that highlighted wound-specific information. This sheet was given to the patient during each weekly visit and discussed with them to ensure their understanding.

RESULTS

Comparing the patient data entered into the WEMR database with the literature resulted in the creation of a wound-specific framework with applicable corrective actions for each entered variable. Details of the information gathered for each variable contributing to chronic, nonhealing wounds are detailed as follows, along with tables showing the evidence-based corrective actions.

Nutrition status: A patient's nutrition status plays a vital role not only in wound healing,[1] but also in overall general health. Malnutrition, or the lack of proper nutrition, has been shown to significantly increase the risk of pressure injury formation, highlighting the need for routine body mass index assessment.[2] Evaluation of nutrition status comprises multiple components. History and physical examination should include evaluation of mobility, dentition, cognitive impairment, fat/muscle wasting, weight change, use of multiple medications, depression, and alcohol consumption.[27] Evaluation of historic laboratory markers such as albumin and prealbumin remains controversial because of their response to physiological stress, not only malnutrition.[28] If laboratory markers are used, a focus on trends over time versus single values is recommended. There is no definitive way to determine if an older adult patient is malnourished; however, diagnostic tools (such as the Mini Nutritional Assessment,[29] the Subjective Global Assessment,[30] and the Canadian Nutrition Screening Tool[31]) can provide reliable information (Table).[28]

Glycemic control: Diabetes mellitus is also known to delay wound healing;[1] therefore, glycemic control is critical to the well-being of the patient. Hemoglobin A_{1c} (HbA_{1c}) is a marker of glycemia that should be measured every 3 months in patients with diabetes.[32,33] One of the well-known complications of diabetes is the inhibited healing process and formation of chronic wounds through multiple mechanisms.[34,35] Once diabetes has been diagnosed (HbA_{1c} >6.5%), the target HbA_{1c} level should be based on the physiologic status of the patient (eg, nil per os vs feeding, critically ill status).[36] In addition, a 60-second screening tool can be used to detect a high-risk diabetic foot and aid in preventing well-known complications such as ulcers and amputation (Table).[37]

Lipid profile: Optimizing of cholesterol levels is imperative for both the prevention and management of peripheral arterial disease, a significant contributor to nonhealing wounds.[7,38] Specifically in patients with diabetes, maintaining optimal lipid levels can lower the risk of microvascular disease development.[38] The lipid profile comprises total cholesterol, high-density lipoprotein, low-density lipoprotein, and triglycerides (Table).

Vascular function: Insufficient or compromised vascular function (ischemia or venous insufficiency) can lead to the formation of nonhealing wounds, particularly on the lower extremities, and may require vascular intervention in order to heal. Evaluation of the patient's vascular status includes both the arterial and venous systems. Workup for arterial ischemia consists of a history and complete physical examination, including a lower extremity pulse examination, ankle brachial index, toe brachial index, pulse volume recording, and transcutaneous oximetry (TCOM). Imaging options include contrast angiography, computed tomography angiography, or magnetic resonance angiography. If the ankle brachial index is less than 0.9 or greater than 1.3,[39,40] the toe brachial index is less than 0.7,[41] or the waveforms on pulse volume recording show a loss of the dicrotic notch, decreased amplitude, dampened contour with broad rounded peaks, and equal upstroke and downstroke time,[41,42] the patient may have lower extremity ischemia, and a TCOM and angiography should be obtained.

A TCOM of less than 30 mm Hg[43] confirms ischemia. If the TCOM reverses after breathing 100% oxygen or with a trial of hyperbaric oxygen (ie, the TCOM obtained in the hyperbaric oxygen chamber is >200 mm Hg), the patient is considered a good candidate for adjuvant hyperbaric oxygen therapy.[44] Angiography may be performed with an intention to treat amenable lesions discovered in the lower extremities. The angiography catheter is placed into the contralateral femoral artery in a retrograde fashion for evaluation of the distal aorta, iliac, femoral, popliteal, and tibial arteries of the extremity with the wound. If the patient has had a prior endovascular aortic aneurysm repair, femoral-femoral bypass graft, or an occluded contralateral iliofemoral system, the ipsilateral femoral artery can be accessed in an anterograde fashion.

For patients with venous ulcerations, assessment of the venous system should be used to evaluate venous insufficiency as a cause of nonhealing wounds. Duplex ultrasonography grades the degree of retrograde flow based on duration of flow in milliseconds in various vein segments with the patient in a standing position.[45] The cutoff value for reflux in the superficial veins, deep femoral veins, and deep calf veins is greater than 500 milliseconds (ms).

Table.
PROVIDER FRAMEWORK FOR TREATMENT AND CARE

Etiology	Assessment	Possible Options/Actions
Nutrition	Signs of malnutrition • Muscle wasting • Fat wasting • Edema • Ascites • Diminished functional capacity • Greater than 10% weight loss in 2 wk Mini Nutritional Assessment score <24 Canadian Nutrition Screening Tool >2 yes Subjective Global Assessment >2 Body mass index <18.5 kg/m^2 Vitamin D <20 pg/mL	Obtain daily calorie count for hospitalized patients Prescribe appetite stimulants Tolerating per-os intake: Provide supplemental oral intake (concentrated caloric and protein formulations) Nil per os: Consider tube feedings or total parenteral nutrition Daily multivitamin • Stage 3 or 4 pressure injury/ulcer: give vitamin C (1,000 mg/d or 500 mg twice per day) and zinc sulfate (220 mg/d) • Give vitamin A (20,000 [IU] daily for 2 wk) if patient is also taking steroids • If vitamin D level <10 pg/mL, start 50,000 IU oral vitamin D_2 or D_3 weekly for 6 to 8 wk, then 1,000 IU vitamin D_3 daily • If vitamin D level 10–20 pg/mL, start 2,000 IU vitamin D_3 daily and repeat serum level in 3 mo, increase dose if serum level remains low
	Body mass index >35 kg/m^2	Initiate weight loss program[24]
Diabetes	HbA_{1c} >6.5%	Hospitalized patient with diabetes: Initiate insulin therapy[28–30] Diabetic diet Monitor point-of-care glucose such as fingersticks per institution protocol Repeat HbA_{1c} every 3 mo to monitor glucose control Lifestyle modification[31]
Lipid profile	Total cholesterol >240 mg/dL Low-density lipoprotein cholesterol >160 mg/dL High-density lipoprotein cholesterol <40 mg/dL Triglycerides >200 mg/dL	Lifestyle modification: aerobic exercise, weight loss, decrease saturated fat consumption[34,35] Moderate-dose statin therapy and recheck levels at 6 wk then every 12 mo
Arterial insufficiency	Ankle brachial index <0.9 or >1.3 Toe brachial index <0.7 Pulse volume recording • Loss of dicrotic notch • Dampened contour • Increased upslope time • Broad/round peaks Transcutaneous oximetry <40 mm Hg Computed tomography angiogram or magnetic resonance angiogram • Infrapopliteal arterial lesion(s)	Revascularization • Balloon angioplasty • Stent • Atherectomy • Open bypass or endarterectomy Hyperbaric oxygen therapy if transcutaneous oximetry >200 mm Hg in the chamber Wound debridement after revascularization, unless infectious source control is required
Venous insufficiency	Physical examination • Varicosities • Venous ulceration • Hyperpigmentation • Edema Ultrasound • Identifiable venous reflux	Conservative/noninvasive • Pneumatic compression • Multilayer compression therapy • Exercise • Weight loss • Control of hypertension Invasive management • Ablation • Phlebectomy • Ligation • Sclerotherapy

(continues)

Table.
PROVIDER FRAMEWORK FOR TREATMENT AND CARE, CONTINUED

Etiology	Assessment	Possible Options/Actions
Renal insufficiency	Creatinine • >0.3 mg/dL • Increased >50% Glomerular filtration rate • <60 mL/min per 1.73 m^2	If no diuretics: Obtain a fractional excretion of sodium or blood urea nitrogen/creatinine and correct prerenal or renal source Nil per os and prerenal: Fluid bolus (sodium chloride, lactated Ringer's solution, 5% dextrose in 0.45% normal saline) Tolerating per os and prerenal: Encourage fluid intake Chronic kidney disease if <60 mL/min per 1.73 m^2 Control blood pressure, diabetes, hyperlipidemia[46,47] Initiate angiotensin-converting enzyme inhibitor or angiotensin receptor blocker if proteinuria present Renal diet Avoid nephrotoxins such as nonsteroidal anti-inflammatory drugs
Osteomyelitis	Suspected	Obtain imaging • X-ray • Magnetic resonance imaging • Bone scan • White blood cell scan Obtain pathology • Computed tomography–guided bone biopsy • Sterile bone biopsy for pathology and culture during wound debridement
	Confirmed	Acute osteomyelitis • Initiate 6-wk intravenous antibiotics per species sensitivities • Weekly wound debridement Chronic osteomyelitis • Hyperbaric oxygen therapy • Antibiotics if not previously treated or clinically worsening wound
Off-loading	Heel ulcer	Total contact casting for diabetic foot ulcers if no infection or ischemia Removable cast walker if frequent wound inspection anticipated Heel suspension device or foam cushion while in bed Custom-molded orthotics Charcot Restraint Orthotic Walker Anterior foot off-loader device
	Sacral pressure injury/ulcer Stage 3 Stage 4 Unstageable Multiple ulcers Surgical graft/flap	Dynamic air flotation Low-air-loss mattress Air-fluidized support surface
	Venous ulcer	Multilayer compression therapy
Neuropathy	Suspected	Perform Focused Neuropathy Evaluation Semmes-Weinstein 10 g monofilament Assessment of ankle reflexes Assessment of foot strength Large fiber: perception of vibration using a 128-Hz tuning fork
	Confirmed	Correction of underlying disorder HbA_{1c} control Nutritional deficiency Stop causative agents Pain control: gabapentin, pregabalin, topical lidocaine

(continues)

Table.
PROVIDER FRAMEWORK FOR TREATMENT AND CARE, CONTINUED

Etiology	Assessment	Possible Options/Actions
Anemia	Hemoglobin <11.0 g/dL	Iron studies: supplement oral iron if indicated • Iron level, ferritin, transferrin, complete blood count with differential, platelet count, reticulocyte count, mean corpuscular volume, blood smear Erythropoietin if chronic kidney disease Transfusion • <6 g/dL • <8 g/dL if perioperative • <10 g/dL and symptomatic or bleeding
Pathology	Abscess	Additional debridement needed if not healing
	Fibrosis	Regenerative medicine can be applied
	Gangrene	Rule out ischemic etiology
	Granulation tissue	Preparation for application of skin graft
	Hyperkeratosis/parakeratosis	Often interchangeable, additional debridement if not healing
	Necrosis	Needs further excision if not healing
	Acute/chronic osteomyelitis	Clinical implication based on protocols[3]
Inflammation	Markers of inflammation • C-reactive protein >3.0 mg/L • Erythrocyte sedimentation rate >30 mm/h • Lactate >2.2 mmol/L • Procalcitonin >0.50 mg/mL • White blood cell count >11,000/μL	Identify potential source • Physical examination • Imaging • Culture (eg blood, wound, urine) • Rule out autoimmune etiology
Wound area	Decreasing size	Continue current management
	Plateau/no change in size	Additional debridement needed
	Increasing size	Assess for infection or correction of underlying etiology

Abbreviation: HbA_{1c}, hemoglobin A_{1c}; IU, international units.

The cutoff value for reflux in the femoropopliteal segment is 1,000 ms. The cutoff value for outward flow in perforating veins is 350 ms. If venous insufficiency is found, surgical interventions include phlebectomy, sclerotherapy, ligation, and endovenous ablation therapy (Table).[46]

Renal function: The incidence of ulcers, amputations, and all-cause hospitalizations is high for patients with both diabetes and ulceration or diabetes and renal disease requiring hemodialysis; however, patients on hemodialysis have disproportionately higher rates of foot-related hospitalizations.[47] Patients with diabetes encompass a large proportion of the wound population, and renal complications are a known sequela of uncontrolled diabetes. Therefore, surveillance and optimization of renal function in patients with diabetes are essential to chronic wound care.

The renal function of patients can be assessed by obtaining serum creatinine and the estimated glomerular filtration rate using the isotope dilution mass spectrometry traceable Modification of Diet in Renal Disease study equation. An increase in serum creatinine greater than 0.3 mg/dL within 48 hours or an increase by 50% is diagnostic for acute kidney injury.[48] A glomerular filtration rate persistently less than 60 mL/min per 1.73m^3 for 3 months is diagnostic of chronic kidney disease (Table).[4]

Osteomyelitis: When present, osteomyelitis (infection of the bone) is known to complicate and often prolong healing of wounds.[49,50] Osteomyelitis must be ruled out in any ulcer with signs of infection (eg, draining sinus) overlying a bony prominence or hardware and when an ulcer probes to the bone. When osteomyelitis is suspected clinically, X-ray and magnetic resonance imaging or bone scan can be performed. Erythrocyte sedimentation rate is reported to be 100 mm/h or more in patients with chronic osteomyelitis[51] and should be obtained to monitor the response to therapy. Histopathologic diagnosis of osteomyelitis is obtained by sterile bone biopsy, either computed tomography guided or during operative wound debridement and supported by deep microbial cultures (Table).[12,52]

Off-loading: Proper pressure off-loading of at-risk patients (eg, patients who are bedbound or wheelchair-bound, those with comorbid diabetes) is a well-known intervention to prevent or treat indicated wounds.[53,54] Patients should be assessed for proper off-loading during each clinic visit. For patients with foot or heel wounds, off-loading options include off-loading shoes, orthotics, total contact casting, short leg walkers, and felted foam dressings.[55] For bedbound patients with hip or sacral pressure injury, assess for the use of static or dynamic mattress surfaces and frequent repositioning. For patients who use wheelchairs or spend a lot of time sitting, off-loading may be accomplished by the use of protective cushioning, padding, and pillows.[56] To assess the risk of developing a pressure injury, the Braden scale can be used to evaluate patients, with possible scores ranging from 6 to 23 (very high risk to low risk; see Table).[57]

Neuropathy: Neuropathy is also known to have a deleterious effect on wound healing.[58,59] Assessment of peripheral neuropathy can be performed using the Focused Neuropathy Evaluation. This evaluation includes symptoms (unsteady gait, numbness of the hands or legs), medical history (diabetes, nephropathy, retinopathy, stroke, prior brain magnetic resonance imaging), and a physical examination (cranial nerve examination, motor and sensory testing, ankle reflexes, and presence of ulcerations) to determine the likelihood of neuropathy. Sensory testing should be performed based on the patient's perception of vibration (tuning fork placed at the bilateral bony prominences of the great toes and knees), temperature, and pain (monofilament testing of the bilateral great toe and midcalf). A spectrum of symptomatic severity exists in sensory neuropathy; however, up to 50% of patients may be asymptomatic but are at great risk of injury to their insensate feet.[60] In addition, an abnormal neurological evaluation combined with signs such as back or neck pain with preserved reflexes and decreased sensation should prompt a further neurologic workup to rule out other causes of the neuropathy (eg, disc herniation or compression, bony abnormality).

Previously, at the authors' institution, a number of patients with an abnormal neuropathy screen were found to have diagnoses other than diabetic peripheral neuropathy (Table). It is critical to test the HbA_{1c} of every new patient seen as many patients will present with diabetes for the first time and have symptoms of neuropathy. More important, even in the presence of neuropathy, it is vital to determine if there is an additional cause of the neuropathy other than diabetes.

Anemia: A seminal article published in 1966 described the deleterious effect of chronic anemia on wound healing as determined by wound tensile strength.[61] Also, anemia of chronic disease is prevalent in patients with spinal cord injury and pressure injuries; therefore, increased vigilance for anemia is recommended.[62] In the authors' institution, anemia is defined as a hemoglobin less than 11.0 g/dL (Table).

Pathology: Obtaining wound biopsies has been shown to aid in providing a definitive diagnosis and guiding care.[63] For nonhealing wounds that do not respond to standard therapy, a pathologic investigation may reveal a less common underlying cause such as carcinoma, pyoderma gangrenosum, or vasculitis. A wound biopsy may be performed to evaluate the viability of deep tissue margins and rule out pathology such as carcinoma, necrosis, osteomyelitis, and infection.[64] The information obtained from the pathology of patients in this study was grouped and addressed as seen in the Table.

Inflammation: Markers of inflammation are known to be valuable tools for both diagnosis and following the progression of infections such as osteomyelitis.[65–69] Threshold values stated are based on ranges obtained from the authors' on-campus laboratory. However, it is well known that markers of inflammation can be elevated for a variety of nonspecific or noninfectious reasons. Therefore, a focus on trends over time versus single values is recommended to gauge response to any therapeutic interventions (Table).

Wound area: Wound measurement is a necessary component of wound management, allowing providers to monitor change in wound size over time and guiding treatment decisions.[70] Planimetry has been shown to be more precise and reliable compared with conventional methods;[71] however, it is complex to implement clinically. In the authors' center, a ruler was used to capture the length, width, and depth of each wound during the weekly clinic visit; in addition, a digital photograph was uploaded for planimetry to determine the wound area (Table).

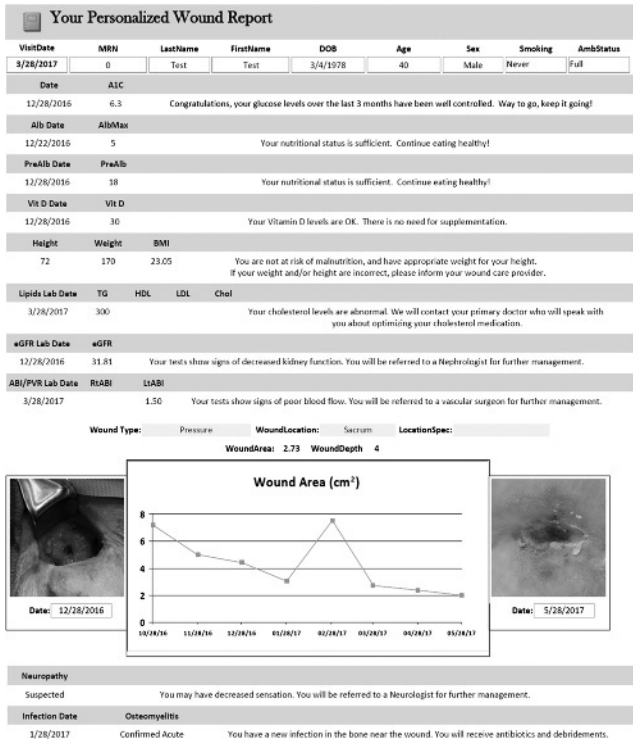
Incontinence management: In addition to ensuring proper off-loading for at-risk patients (eg, patients who are bed- or wheelchair-bound), providers must pay attention to both urinary and fecal continence. Incontinence-based complications have been shown to play a significant role in the formation and recurrence of nonhealing wounds,[72,73] particularly those located on the lower back/pelvic regions. Patients in this study with a history of fecal or urinary incontinence were assessed for dryness of the wound, and their home incontinence regimen was documented, because protective skin care is known to decrease the chance of moisture-associated skin damage.[74]

Urinary incontinence management options include frequent changing, super-absorbent pads, topical barriers, intermittent catheterization or temporary indwelling catheter placement, suprapubic catheterization, or urinary diversion. Fecal incontinence options include timed toileting, stool softeners, colonic stimulants, contact irritants, bulk formers, and diverting colostomies, depending on the needs of the patient. A typical bowel program will consist of a stool softener three times per day adjusted in consideration of concurrent medications, daily schedule, and diet.[75]

Sheet Creation

After each patient's information was entered in the WEMR database, a single-page sheet was generated, as illustrated in

Figure.
WEMR REPORT



A single-sheet data summary was generated and given to patients and their caregivers. The sheet included the wound diagnosis, initial and most recent wound photos, graph of wound area over time, and pertinent test results.

the Figure. Only pertinent wound information and relevant test results were displayed, enabling the sheet to remain concise and easy to read. The simple format facilitated discussion between the patient, caregiver, and provider and ensured patient and family understanding of the information presented.

DISCUSSION

Many current databases focus on the administrative aspects of patient care, such as providing information to coders for billing purposes. In contrast, this framework focuses solely on providing critically essential wound information in a concise format for the provider and patient to discuss. Identifying and tabulating variables that play a role in the development of chronic wounds provides a standard for wound care centers worldwide to optimize patient care and treat nonhealing wounds.

This is a tool that consolidates the innumerable variables related to care of patients with wounds into a single sheet. Wound care providers can use this framework to formulate a best-practice treatment plan that would facilitate wound healing. In consensus with the recent CARE Act, the framework and WEMR sheet facilitate inclusion of the patient and the caregiver in their care, which is critical to improve patient outcomes. This tool aids not only in the management of the wound, but also in the management of comorbidities by highlighting critical aspects of management that can be optimized for favorable outcomes. It is postulated that the use of this tool increases efficiency of care; however, further studies are needed to show the impact on patient outcomes over time (eg, decreased readmissions to an inpatient setting, decreased incidence of wound infection, decreased mortality).

Currently, a significant challenge for the implementation of this framework is the lack of integration between the WEMR and both the inpatient and outpatient electronic medical record. This disconnect requires redundant, manual duplication of data from inpatient or outpatient records into the WEMR. In order to improve this, an interface for automated transfer of data from the hospital/outpatient record systems to the WEMR could be developed. To completely remove this redundancy, the WEMR would need to be incorporated across all forms of electronic medical records within the healthcare system.

It is strongly recommended that each facility uses one electronic medical record for all patients that can be designed to track specific diagnoses such as chronic wounds. It is important to use one system for both inpatient and outpatient care with the ability for each institution to customize and highlight individual preferences to facilitate continuity of patient care by having seamless access to both the inpatient and outpatient records within the same system. Although there are many options available today, four tools are readily usable. These well-integrated commercial electronic medical records provide excellent tech support and are optimized for care of patients with wounds: Wound Expert (Net Health, Pittsburgh, Pennsylvania), Epic (Verona, Wisconsin), Intellicure, Inc (Woodlands, Texas), and Tissue Analytics (Baltimore, Maryland).

Implementation of a framework and WEMR sheet can be invaluable as a tool and resource for providers to offer best practices to every patient by consolidating the vast literature on wound healing guidelines. By highlighting areas of care that were lost to follow-up or not fully addressed, providers in this study were not only able to correct these deficits, but also able to actively involve the patients and their families in their care.

Limitations and Recommendations for Future Study

The goal of this article is to address all of the patient's medical problems as they relate to wound healing. Patient-centered concerns and lifestyle considerations, such as smoking, compliance/adherence to treatment, and pain, although very important to wound healing, are outside of the scope of this framework.

Pain and smoking are commonly addressed, and one of the goals of this framework was to limit focus to variables that may be inadvertently overlooked.

Future areas of study include testing the framework and WEMR sheet's short- and long-term qualitative and quantitative influences on patient quality of life, behavioral health, readmission rate, and the management of bowel and bladder incontinence. In addition, WEMR databases have the potential to serve as a clinical trial tool for chronic wound treatments as part of an electronic data capture system. Studies are also needed to optimize the potential delivery of clinical alerts based on entered data, while avoiding alert fatigue[76] by sending selective, targeted alerts to the appropriate providers at the ideal time.

CONCLUSIONS

Wound healing is dependent on an innumerable number of variables, and attempting to account for and control all of them is not feasible. Implementation of this WEMR framework at a tertiary-care hospital highlighted the categories of chronic wound etiologies that were not being fully investigated, along with cutoff parameters and recommended corrective actions. This list is not meant to be exhaustive, and further studies are likely to result in updates; however, it is intended to work within the parameters of any given institution. In the literature, each outcome variable has an impact on wound healing. This WEMR framework consolidates and analyzes the vast amount of data and provides a single-page summary of wound-relevant information. This enables the provider to deliver the best standard-of-care medicine to each patient, involves the patients in their own care, and reduces the possibility of parameters being overlooked or lost to follow-up.

PRACTICE PEARLS

- A WEMR can be used as a management tool to ascertain that patients with wounds are receiving the standard of care.
- This article provides the evidence-based details to ensure all patients with pressure injuries receive specific treatments for moisture control and proper nutrition on every visit.
- This framework provides a comprehensive, up-to-date checklist for care and specific treatments of inpatients with wounds.
- A single-page summary of wound-relevant information can enable the provider to deliver excellent care, reduce the possibility of variables being overlooked, and help involve the patients in their own care.

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