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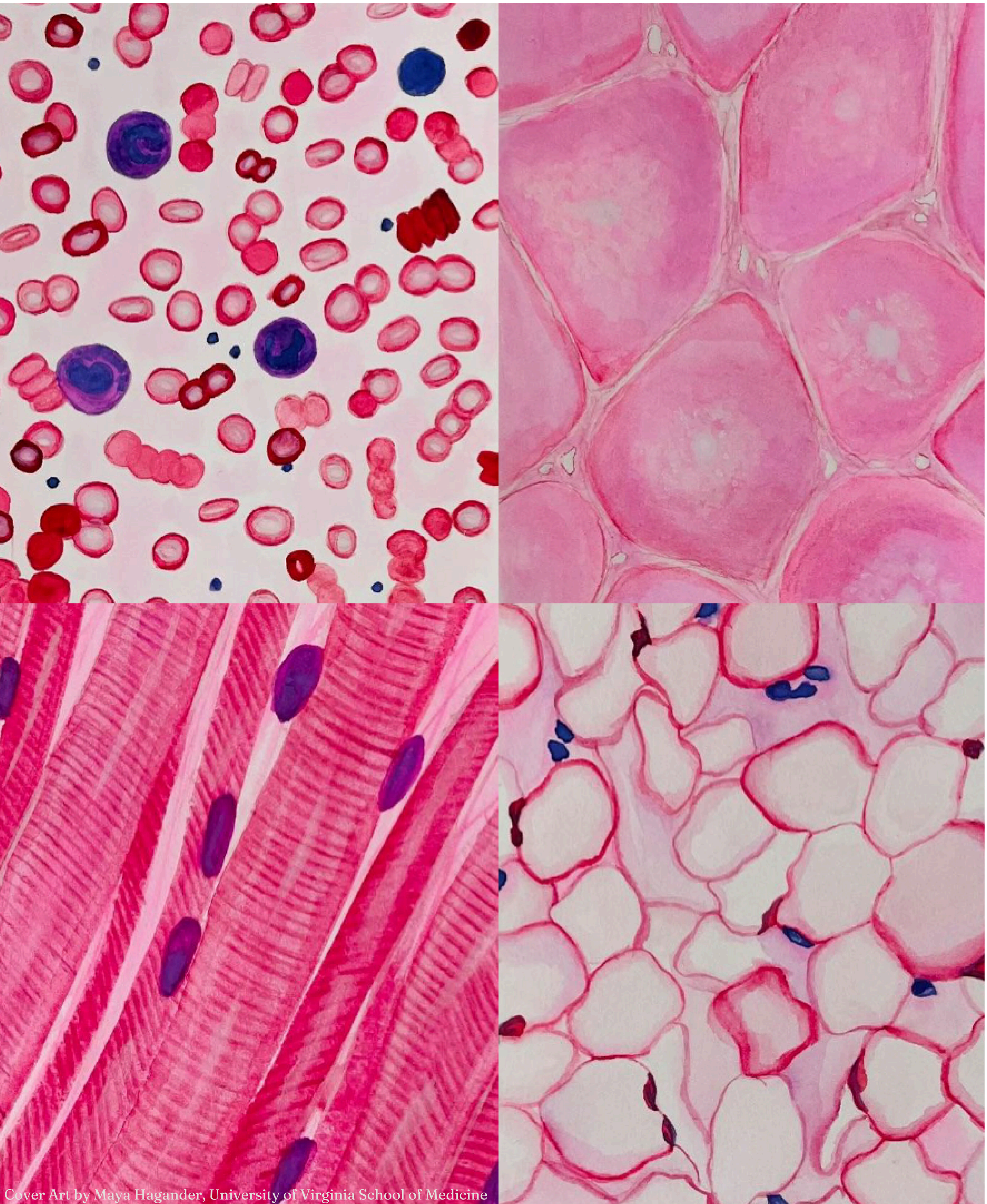

Cover Art by Maya Hagander, University of Virginia School of Medicine

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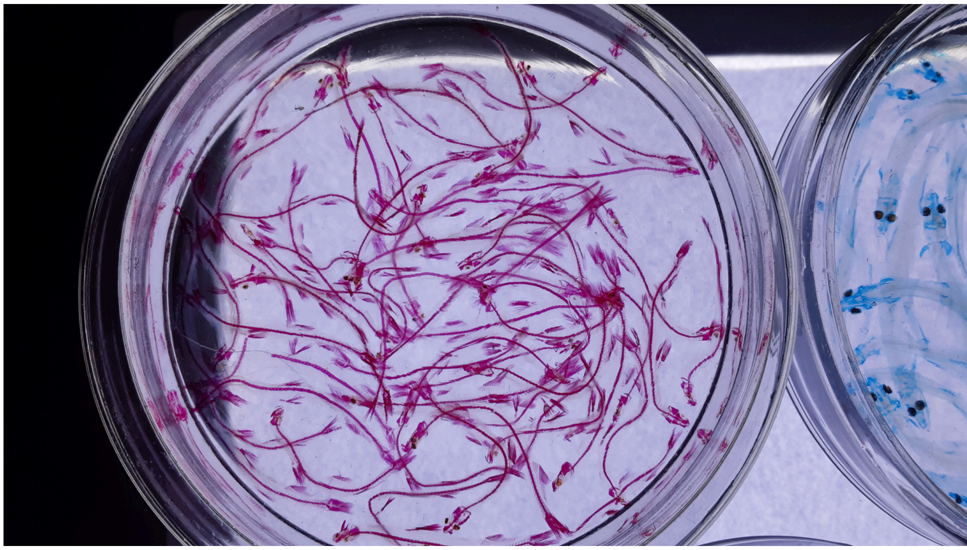

EDITORS' NOTE

Virginia Journal of Medicine

Dear Readers,

We are proud to reintroduce a journal born at UVA—now reimagined as the Virginia Journal of Medicine (VJM)—a renewed platform to elevate the voices, research, and stories of those shaping the future of healing.

Originally launched in 2022 as the University of Virginia Medical Student Review (UVAMSR), this journal began as a space for UVA medical, nursing, and public health students to share their work and perspectives on medicine. Today, we honor that original mission while expanding its reach and potential. With this relaunch, we are setting the stage for a much larger multisite journal—one that connects medical researchers across institutions to foster dialogue, discovery, and shared growth.

This edition features pieces exclusively from UVA medical researchers, whose creativity, insight, and dedication have helped bring this revived issue to life. We are inspired by the depth and diversity of the submissions and grateful to the editors, writers, and mentors who made it possible.

Looking ahead, we are excited to launch a national editorial board for our upcoming fall edition and to open submissions to all academic institutions who aim to publish their research with the Virginia Journal of Medicine. By doing so, we hope to create a vibrant, innovative publication that reflects the evolving landscape of medicine—and the voices shaping its future from all perspectives.

We extend our sincere thanks to the previous editorial team of the UVAMSR, especially Janet Yan and Christian Renwick, for their thoughtful contributions to the content in this edition. Their hard work and vision helped lay the foundation for what is now the Virginia Journal of Medicine, and we are grateful to build on their legacy. To our readers, contributors, and supporters: thank you for joining us in this next chapter. We're honored to share this journey with you.

Ever guided by one enduring principle: *Salus. Scientia. Progressus. Pro Omnibus.*

Warmly,

Catherine Lyons   Aaron D. Smith

Co-Editors in Chief, VJM

HEALING OF PRESSURE INJURIES IN LONG-TERM CARE SETTINGS

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ABSTRACT

Background
Pressure injuries increase the risk of infection, hospital admission, and mortality. Data from acute and long-term care settings indicate that multiple factors including patient demographics, comorbidities, lab values, and wound characteristics are associated with wound healing. However, data for patients in transitional care settings are limited. Data that directly compare location-specific ulcers are also limited.

Objectives
This study aims to identify how patient demographics, comorbidities, lab values, and wound characteristics are associated with healing in pressure ulcers of the sacrum, ischium, and trochanter in a transitional care setting.

Methods
We performed a retrospective chart review of 449 transitional care patients with a diagnosis of pressure injury to the sacrum, ischium, or trochanteric region admitted to a single facility associated with an academic medical center from December 2014 to January 2019. Data parameters included patient demographics, comorbidities, lab values, and wound characteristics. Patients were categorized by pressure wound location (sacral/ischial/trochanteric) and stage, and were divided into healing and non-healing groups.

Results
In this cohort, 301 patients had sacral pressure injuries, 91 had ischial pressure injuries, and 57 had trochanteric pressure injuries. The healing group included 233 patients and the non-healing group included 216 patients. In this transitional care setting, patients with healing pressure ulcers were older (mean age 61.2 vs 56.2 years, $p = 0.001$), were more likely to be females (42.9% vs 31.5%, $p=0.012$), and had shorter lengths of stay (31.6 days vs 49.8, $p<0.001$). Healing wounds were less likely to be greater than stage 3 on admission (59.7% vs 87.0%, $p<0.001$) and had lower rates of paralysis (38.2% vs 54.6%, $p<0.001$) and active osteomyelitis (18.0% vs 33.8%, $p<0.001$). Patients with healing ischial wounds had significantly higher mean hemoglobin levels (9.7 vs 8.9 g/dL, $p=0.017$). Patients with healing sacral wounds had lower rates of end-stage renal disease requiring dialysis (14.5 vs 25.6%, $p=0.016$) and active osteomyelitis (18% vs 34%, $p<0.001$). Unexpectedly, patients with healing pressure wounds had slightly higher Charlson Comorbidity Index scores at 5.6 compared to 5.1 ($p=0.047$) with non-healing pressure wounds.

Conclusions
Our study suggests that wound location and other wound-related characteristics are primary factors associated with delayed wound healing. An evidence-based evaluation of the factors that impact the healing rate of pressure injuries by anatomic location indicates that there is a significant association between delayed wound healing and wound characteristics including larger initial wound surface area, depth, and advanced stage (greater than stage 3), certain patient demographics including age and sex, and comorbidities including paralysis, osteomyelitis, end-stage renal disease, and anemia. The presence of these factors should be carefully assessed to identify patients in the transitional care setting that are particularly vulnerable to delayed wound healing for informing treatment regimens that may optimize healing.

INTRODUCTION

Pressure injuries represent a significant burden on the healthcare system and can lead to negative outcomes such as increased length of hospitalization and even mortality [1]. The Health Research & Educational Trust (HRET) reported that 2.5 million patients in the United States are affected by pressure injuries every year [2]. Complications associated with pressure ulcers include pain, increased infection and sepsis risk, additional surgical procedures, and longer hospital stays [3–6]. The total associated cost of pressure ulcers is approximately $11 billion per year in the US healthcare system, with single injuries costing as high as $70,000 [2]. Initiatives to address this issue include measures for creating risk assessment tools to identify causative agents and implement preventive measures [3], such as the Braden, Waterlow, and Ramstadius tools [4]. Despite efforts to mitigate the impact of pressure ulcers on patients, the overall prevalence of pressure injury wounds in long-term-care settings ranges from 11% to 14.4% [3]. For these patients, the primary management goal shifts from prevention to the achievement of a healed wound.

Wound management of pressure injuries may include providing protective coverings to maintain a moist environment, debridement, pressure relief, infection treatment, or skin grafting depending on severity [5]. Pressure ulcer wound healing typically occurs within 2-4 weeks of treatment [9–12]. Wound healing is affected by both intrinsic patient factors and extrinsic factors including prolonged pressure and shearing forces. Intrinsic factors known to impair wound healing include poor tissue oxygenation, anemia, infections, advanced age, diabetes, obesity, tobacco use, higher sacrococcygeal pressure, and poor nutritional status [13]. Other data points that affect wound healing include body mass index (BMI) and the Charlson Comorbidity Index (CCI), which involves a standardized approach to classifying comorbid conditions to predict 10-year mortality.

Factors associated with impaired wound healing have been evaluated for high risk of pressure ulcer development in both the acute and palliative care setting, with limited data corresponding to the transitional care population, especially with regard to wound location [14]. Factors shown to be associated with pressure ulcers in the acute and palliative care setting include comorbid diabetes, nutrition, hours of vasopressin infusion, length of surgery, and lab values such as lactate, creatine, glucose, hemoglobin, and albumin [15-21]. Prior studies in the acute care and palliative care setting have determined poor wound healing to be associated with limited mobility, low hemoglobin, low mean arterial pressure, insufficient oral intake, infection, and age greater than 80 years old [15, 29-30] Additionally, wound characteristics associated with slower rates of healing in the acute care and outpatient setting included larger initial ulcer size, advanced initial ulcer stage, and presence of associated infection [16].

The purpose of this study is to identify patient demographics, comorbidities, and wound characteristics associated with delayed wound healing in the transitional care setting. In our study, transitional care is defined as a setting for individuals with serious medical conditions who typically require adjunctive treatments including ventilation support, renal replacement and dialysis, feeding and nutrition support, and physical therapy. These patients have been discharged from an acute care setting and require an average length of stay between 25-28 days, which is longer than the standard stay at a typical acute care hospital [17]. For patients with significant medical issues and deconditioning in the transitional care setting, wound characteristics, comorbidities, and lab values should be collectively evaluated to determine which wound-related characteristics and patient-specific factors are present. The identification of parameters associated with an increased risk of impaired healing allows for earlier and more aggressive interventions for these pressure injuries.

MATERIALS & METHODS

Data Collection
Institutional Review Board approval was obtained prior to the start of data collection. A retrospective analysis was performed for all patients with a diagnosis of pressure injury to the sacrum, ischium, or trochanteric region who were admitted to a single transitional care facility associated with an academic medical center from 2014 to 2019. Inclusion criteria were considered to be any patient with a pressure ulcer of the above locations during the five-year date range. The staging of wounds was determined through information provided in the medical record and all pressure injuries of the sacrum, ischium, and trochanter were reviewed.

Pressure Injury Classification
Pressure injuries were identified in a standardized fashion by trained wound care nurses and monitored from admission to discharge. Wound dimensions and stage of injury were recorded in a confidential database. The staging system utilized four stages from the National Pressure Injury Advisory Panel (NPIAP). These included stage one corresponding to disclosed skin, stage two corresponding to the top layer of skin lost, stage three corresponding to an exposed wound in which the fat layer of the skin may be observed, and stage four in which the depth of the wound reaches the bone.4 Pressure injuries were considered regardless of stage, mucous membrane injuries, or device-related status. Patients were divided into two groups – "healing" and "non-healing" – based on the adequacy of wound healing. "Healing" wounds were defined as having a mean healing time of equal to or greater than 8.65% per week, while "non-healing" wounds did not meet this threshold.9–12 Healing time was first calculated as the percentage decrease in surface area of the wound from admission to discharge. The mean healing rate was then determined by dividing the percent decrease in surface area by the length of stay in the facility (in weeks), for a final value representing the percent decrease in surface area per week. The timeline was determined based on the retrospectively collected data. Since wound healing is also affected by wound management, it was assumed that standard practice was employed for the patients in this study, which involved protection, debridement, pressure relief, and depending on severity, infection treatment, or skin grafting.

Patient Demographics
Data involving patient demographics (age, gender), comorbidities (high body mass index, active tobacco use, anxiety/depression, diabetes, dialysis-dependence, paralysis, osteomyelitis, recent trauma, venous thromboembolism, Charlson Comorbidity Index), and lab values (white blood cell count, hemoglobin, hemoglobin A1c, and albumin) at the time of wound documentation were collected from retrospective chart review.

Statistical Analysis
The study size and sample frame were chosen from available data at the time of investigation. Based on power calculations of the stage 3 pressure ulcer incidence data, the minimum number of subjects for adequate study power was 206 participants. The statistical power after data collection was calculated to be 98.6%. Univariate analysis was performed using SPSS 22.0 software® (IBM Corporation, Armonk, NY, USA). Categorical variables were compared using the Chi2 test and results were reported as counts and percentages. Continuous variables were compared using a parametric Student's t-test and results were expressed as mean and standard deviation (SD). The significance threshold was set at $p<0.05$.

RESULTS

Inclusion Criteria
A total of 449 patients admitted to a single transitional care facility between December 2014 and January 2019 had documentation of a pressure injury to the sacrum, ischium, or trochanter, and were therefore included for retrospective review. Within this cohort, 301 patients (67.0%) had sacral pressure injuries, 91 (20.3%) had ischial pressure injuries, and 57 (12.7%) had trochanteric pressure injuries. Based on calculated mean healing rates, patients were divided into two groups – healing and non-healing. The healing group included 233 (51.9%) patients and the non-healing group included 216 (48.1%) patients.

Patient Demographics
A demographic analysis of comorbidities for this patient population was performed (Table 1). The mean age of patients included in this cohort was 59 years. The average patient age in the healing group was 61±15 years, which was older than the average patient age of 56±16 years in the non-healing group (p=0.001). There was a higher predominance of males diagnosed with pressure injuries at 62.6%. The healing group had a higher percentage of female patients at 43% compared to 38% (p=0.012) of female patients in the non-healing group. The average body mass index (BMI) was 27.8 within the entire cohort, with higher BMIs noted in the healing group at 28.7 compared to the non-healing group at 26.8 (p=0.037).

Wounds in the healing group were less likely to be greater than stage 3 on admission with 59.7% in the healing group having an injury greater than stage 3 compared to 87.0% (p<0.001) in the non-healing group. Compared to healing wounds with a mean initial surface area of 19.5 cm^2, non-healing wounds had a significantly higher mean initial surface area of 35.4 cm^2 (p<0.001). Healing wounds were measured to have mean initial depths of 1.19 cm compared to 1.94 cm (p<0.001) for non-healing wounds. Patients in the non-healing group had significantly longer overall lengths of hospitalization at 49.8 days compared to 31.6 days (p<0.001) in the healing group. There was no significant difference in patient lab values commonly used to evaluate nutrition and healing potential between groups. There was no difference in rates of active tobacco use (p=0.222), anxiety/depression (p=0.312), diabetes (p=0.137), dialysis dependence (p=0.171), recent trauma (p=0.688), or venous thromboembolism (p=0.386). Patients with non-healing wounds were also more likely to be paralyzed at 55% compared to 38% (p<0.001) of patients in the healing wound group. Patients with non-healing wounds had higher rates of active osteomyelitis at 34% compared to 18% (p<0.001) in the healing group. Unexpectedly, patients with healing pressure wounds had higher Charlson Comorbidity Index scores of 5.6 compared to 5.1 (p=0.047) for those patients with non-healing pressure wounds.

Patient Characteristics by Pressure Injury Location
Analysis of patient characteristics was performed based on pressure injury wound location (Tables 2, 3, 4). It was observed that patients with healing pressure ulcers in all wound locations were older with a mean age of 61.2 years compared to non-healing pressure ulcers with a mean age of 56.5 years (p=0.001). For sacral pressure injuries, a mean age of 62.7 years was calculated for the healing group compared to a mean age of 58.4 years (p=0.14) in the non-healing group. A higher percentage of female patients was identified with 42.9% female participants in the healing group for all wounds compared to 31.5% females (p=0.012) in the non-healing group. The percentage of female patients with healing ischial pressure ulcers was 38.2% compared to 19.3% of female patients (p=0.047) with non-healing ischial pressure ulcers.

The healing groups corresponding to all three wound locations had lower rates of initial wound stage >3. In the sacral wound group, 59.3% of patients with healing sacral wounds had an initial wound stage >3 compared to 87.6% of patients (p<0.001) with non-healing sacral wounds. Pertaining to ischial wounds, a consistent observation was noted, with 64.7% of patients with healing wounds having an initial wound stage >3 compared to 89.5% of patients (p<0.001) with non-healing wounds. Similarly, 55.6% of patients with healing trochanteric wounds were found to have an initial wound stage >3 compared to 80.0% of patients (p=0.004) with non-healing trochanteric wounds. Healing sacral and ischial wounds had smaller mean initial surface areas of 19.3 cm^2 and 12.8 cm^2 respectively, compared to 36.2 cm^2 and 23.2 cm^2 (p=0.016 and p=0.002, respectively) for non-healing wounds in these locations. Additionally, healing sacral and trochanteric wounds were noted to have decreased mean initial depth at 0.98 cm and 1.24 cm respectively compared to 1.75 cm and 2.66 cm (p<0.001 and p=0.007, respectively) for non-healing sacral and trochanteric wounds.

Table 1: All pressure injuries - Healing vs Non-Healing Wounds (n = 449)

	Healing (n = 216)	Non-Healing (n = 233)	p-values
Demographics			
Mean age, years	61.2 ± 14.9*	56.5 ± 15.9*	0.001
Mean Body Mass Index (BMI)	28.7 ± 10.6*	26.8 ± 9.1*	0.037
Female (%)	42.9*	31.5*	0.012
Comorbidities (%)			
Active tobacco use	13.4	17.6	0.222
Anxiety/depression	35.2	39.8	0.312
Diabetes	46.8	39.8	0.137
Dialysis dependent	14.6	19.4	0.171
Osteomyelitis	18.0*	33.8*	<0.001
Paralysis	38.2*	54.6*	<0.001
Recent trauma	4.3	5.1	0.688
Venous thromboembolism	31.3	35.2	0.386
Charlson Comorbidity Index (CCI)	5.63 ± 2.7*	5.11 ± 2.8*	0.047
Length of Stay at LTACH (days)	31.6 ± 13.3*	49.8 ± 38.6*	<0.001
Labs			
Albumin	2.75 ± 0.5	2.72 ± 0.5	0.656
Hemoglobin A1c	5.72 ± 1.6	5.53 ± 1.4	0.181
Hemoglobin	9.06 ± 1.5	8.90 ± 1.3	0.255
White Blood Cell Count	8.85 ± 3.6	9.30 ± 3.9	0.179
Wound Characteristics			
Initial wound surface area (cm^2)	19.5 ± 40.1*	35.4 ± 53.7*	<0.001
Initial wound depth (cm)	1.19 ± 1.4*	1.94 ± 1.8*	<0.001
Initial wound stage > 3 (%)	59.7*	87.0*	<0.001

Values listed as mean +/- standard deviation.* Indicates statistical significance (p < 0.05)

Table 2: Sacral Pressure Injuries - Healing vs Non-Healing Wounds (n = 301)

	Healing (n = 172)	Non-Healing (n = 129)	p-values
Demographics			
Mean age, years	62.7 ± 14.2*	58.4 ± 16.0*	0.014
Mean Body Mass Index (BMI)	28.8 ± 10.2	26.9 ± 8.5	0.071
Female (%)	44.8	37.2	0.188
Comorbidities (%)			
Active tobacco use	14.0	17.1	0.459
Anxiety/depression	36.0	42.6	0.246
Diabetes	48.8	41.1	0.181
Dialysis dependent	14.5*	25.6*	0.016
Osteomyelitis	13.4*	26.4*	0.004
Paralysis	26.2	36.4	0.056
Recent trauma	5.8	6.2	0.888
Venous thromboembolism	29.1	34.1	0.351
Charlson Comorbidity Index (CCI)	5.90 ± 2.8	5.40 ± 2.8	0.125
Length of Stay at LTACH (days)	31.8 ± 13.9*	51.3 ± 41.2*	<0.001
Labs			
Albumin	2.74 ± 0.5	2.76 ± 0.5	0.679
Hemoglobin A1c	5.79 ± 1.7	5.65 ± 1.4	0.468
Hemoglobin	8.92 ± 1.4	8.97 ± 1.3	0.761
White Blood Cell Count	8.85 ± 3.6	9.70 ± 4.3	0.068
Wound Characteristics			
Initial wound surface area (cm^2)	19.3 ± 40.4*	36.2 ± 53.8*	0.002
Initial wound depth (cm)	0.98 ± 1.1*	1.75 ± 1.6*	<0.001
Initial wound stage > 3 (%)	59.3*	87.6*	<0.001

Values listed as mean +/- standard deviation.* Indicates statistical significance (p < 0.05)

The group of patients with healing ischial pressure ulcers had a significantly higher mean hemoglobin level at 9.7 g/dL compared to 8.9 g/dL (p= 0.017) in the non-healing ischial pressure group. Otherwise, no significant differences were noted in laboratory values including albumin, hemoglobin A1c, and white blood cell count between healing and non-healing groups for patients with sacral, ischial, and trochanteric wounds (Table 3). The group of patients with healing sacral wounds had lower rates of end-stage renal disease requiring dialysis at 14.5% compared to 25.6% (p=0.016) in the non-healing sacral wound group. Diagnoses of active osteomyelitis were also lower in the healing sacral wound group at 13.4% compared to 26.4% (p=0.004) in the non-healing group. No significant differences were noted for multiple comorbidities in patients in the healing group versus the non-healing group for ischial and trochanteric pressure injuries (Tables 3 and 4).

DISCUSSION

Limited data exist for pressure injury healing in patients in the transitional care setting and for how wound location impacts pressure healing. The purpose of this study is to identify factors that influence wound healing with particular consideration given to wound location to more effectively guide the management of pressure injuries in the transitional care setting.

Of the 449 patients included in the retrospective review, 51.9% had pressure injuries that were categorized as healing based on calculated mean healing rates of 57.1% for sacral wounds, 47.4% for trochanteric wounds, and 37.4% for ischial wounds. Overall, patient factors associated with those in the healing group included slightly older age, female gender, and shorter lengths of stay in the long-term facility. Factors seen in patients with non-healing wounds included larger wound surface area, greater depth, advanced stage (greater than stage 3), slightly lower BMI, slightly lower Charlson Comorbidity Index, a diagnosis of paralysis, and a diagnosis of associated osteomyelitis. Notably, with the exception of hemoglobin values in ischial injuries, non-healing pressure injuries were not found to be significantly associated with malnutrition (low albumin), anemia (low hemoglobin), diagnosis of diabetes/elevated hemoglobin A1c levels, or active tobacco use.

The Charlson Comorbidity Index (CCI) is a standardized approach for classifying comorbid conditions to predict the 10-year mortality of a patient. Prior studies have shown a correlation between higher CCI scores and the risk of pressure ulceration in the outpatient setting, and higher CCI scores and delayed wound healing in outpatient geriatric burn patients [18-19]. In this study, CCI scores were compared between the healing and non-healing groups. Notably, patients with healing pressure injuries were found to have slightly higher CCI scores (5.6 vs. 5.1, p=0.047). However, the clinical implications of this are unclear, as both groups' average CCI scores would be rounded to 5, which equates to the same estimated 10-year survival of 21%. Increasing age correlates with increased CCI scores, therefore higher CCI scores in the healing group could be attributed to the older average age. The average age of the healing group was 61 years old, which adds 2 points to the CCI score, while the average age of the non-healing group was 56 years old, adding only 1 point to the overall CCI score [26-27]. In the acute care, short-term nursing, and home health nursing settings, no significant association between patient age and healing was noted. Additionally, in the acute and short-term care settings, the average patient age was much older (67.5 – 78.1 years old) relative to the average age in this transitional care cohort [24,25,29].

Comorbidities including paralysis may impair the process of wound healing from sensory and motor loss, as well as other associated symptoms including spasticity, neurogenic bladder/bowel, and metabolic syndrome that make it difficult to prevent and manage pressure injuries [37]. We observed significant associations with non-healing in patients with paralysis involving any pressure injuries regardless of their location. Osteomyelitis is generally believed to be a complication of pressure ulcers, where an infection spreads from the skin to the bone. We observed a correlation between non-healing and osteomyelitis in pressure injuries of all locations, particularly those injuries located in the sacrum.

Prior studies have established that extremes in patient weight – both underweight and obese – are risk factors for pressure injury development. [30-31]. The majority of patients in our cohort were classified as normal or overweight based on body mass index, or BMI (mean 27.7, range 13.5 to 70.4). While a statistically significant difference was noted in average BMI between healing (28.7) and non-healing (26.8) groups, the clinical significance of this finding is unclear as these averages both fall into the category of "overweight" (BMI of 25.0 to 29.9) [13].

We also found a significantly higher percentage of female patients in the healing group – which is unique compared to findings from studies evaluating pressure injuries in other care settings that showed no significant difference based on gender [23,31,36]. Studies evaluating factors that impact wound healing have reported evidence of a positive effect of estrogen in the acceleration of cutaneous wound healing in both elderly men and women through the downregulation of the macrophage migration inhibitory factor [32].

Hemoglobin and albumin are the laboratory values that were used as markers of anemia and malnutrition, respectively [13]. Previous studies in hospitalized populations have identified low hemoglobin and serum albumin as risk factors for pressure ulcer development and impaired healing [33-34]. Decreased hemoglobin is associated with anemia and is generally correlated with increased time required for healing. Studies suggest that better nutritional status or oxygen perfusion is essential for optimal wound healing [35]. Given the decreased production of the hormone erythropoietin (EPO), end-stage renal disease may further exacerbate anemia. Other factors associated with end-stage renal disease that may delay wound healing include electrolyte imbalances, chronic inflammation, and metabolite accumulation [36].

The average hemoglobin value was 9 g/dl and the average albumin was 2.7 g/dL for patients in our transitional care patient cohort across both healing and non-healing groups for all locations. However, except for ischial pressure injuries, we did not observe a significant difference in hemoglobin levels for wound healing based on location. Albumin levels did not appear to impact the pressure injury wound healing rate. Furthermore, we observed that patients with healing sacral wounds had lower rates of end-stage renal disease requiring dialysis at 14.5% compared to 25.6% in the non-healing sacral wound group (p=0.016) and lower rates of active osteomyelitis at 13.4% compared to 26.4% (p=0.004) in the non-healing group.

Table 3: Ischial Pressure Injuries – Healing vs Non-Healing Wounds (n = 91)

	Healing (n = 34)	Non-Healing (n = 57)	p-values
Demographics			
Mean age, years	54.9 ± 16.2	54.5 ± 16.0	0.906
Mean BMI	28.3 ± 7.1	24.8 ± 9.8	0.051
Female (%)	38.2*	19.3*	0.047
Comorbidities (%)			
Active tobacco use	15.6	14.0	1.00
Anxiety/depression	44.1	33.3	0.304
Diabetes	44.1	38.6	0.604
Dialysis dependent	5.9	7.0	1.00
Osteomyelitis	38.2	47.4	0.396
Paralysis	67.6	78.9	0.230
Recent trauma	0.0	1.8	1.00
Venous thromboembolism	35.3	33.3	0.849
Charlson Comorbidity Index (CCI)	4.68 ± 1.8	5.05 ± 3.1	0.519
Length of Stay at LTACH (days)	31.2 ± 10.6*	46.5 ± 33.3*	0.011
Labs			
Albumin	2.82 ± 0.5	2.73 ± 0.4	0.407
Hemoglobin A1c	5.78 ± 1.7	5.38 ± 1.3	0.214
Hemoglobin	9.68 ± 1.5*	8.92 ± 1.4*	0.017
White Blood Cell Count	10.03 ± 4.0	9.18 ± 3.54	0.299
Wound Characteristics			
Initial wound surface area (cm^2)	12.8 ± 13.9*	23.2 ± 22.3*	0.016
Initial wound depth (cm)	2.21 ± 2.3	1.99 ± 1.7	0.622
Initial wound stage > 3 (%)	64.7*	89.5*	0.004

Values listed as mean +/- standard deviation.* Indicates statistical significance ($p < 0.05$)

Table 4: Trochanteric Pressure Injuries – Healing vs Non-Healing Wounds (n = 57)

	Healing (n = 27)	Non-Healing (n = 30)	p-values
Demographics			
Mean age, years	59.7 ± 15.7	52.3 ± 14.6	0.070
Mean BMI	28.8 ± 10.2	26.8 ± 8.5	0.071
Female (%)	37.0	30.0	0.574
Comorbidities (%)			
Active tobacco use	7.4	26.7	0.083
Anxiety/depression	18.5	40.0	0.077
Diabetes	37.0	36.7	1.00
Dialysis dependent	25.9	16.7	0.519
Osteomyelitis	22.2	40.0	0.149
Paralysis	77.8	86.7	0.378
Recent trauma	0.0	6.7	0.492
Venous thromboembolism	40.7	43.3	0.843
Charlson Comorbidity Index (CCI)	5.11 ± 2.6	3.97 ± 2.4	0.095
Length of Stay at LTACH (days)	31.4 ± 12.5*	49.2 ± 37.6*	0.023
Labs			
Albumin	2.71 ± 0.6	2.54 ± 0.5	0.252
Hemoglobin A1c	5.24 ± 0.9	5.29 ± 1.5	0.891
Hemoglobin	9.16 ± 1.8	8.50 ± 1.3	0.129
White Blood Cell Count	7.42 ± 2.4	8.07 ± 2.5	0.891
Wound Characteristics			
Initial wound surface area (cm^2)	29.6 ± 56.6	55.0 ± 83.2	0.189
Initial wound depth (cm)	1.24 ± 1.1*	2.66 ± 2.4*	0.007
Initial wound stage > 3 (%)	55.6*	80.0*	0.047

Values listed as mean +/- standard deviation.* Indicates statistical significance ($p < 0.05$)

However, this study is not without limitations. Results are based on data from a single transitional care facility and therefore may not be generalizable to other transitional care settings. The retrospective nature of this study is limited to the available data, and the accuracy of this data is dependent upon accurate documentation within the electronic medical system. Given the retrospective nature of the review, wound treatment would be considered a confounding variable since these data were limited to what was described in medical records. Since it was difficult to determine complete wound healing, this measure was not considered as an endpoint. Additionally, the mean healing rate was calculated based on an assumption of a uniform healing speed due to limitations in the electronic medical record data. Although there were many factors affecting the actual healing process, the mean healing rate was calculated by dividing the percent decrease in surface area by the length of stay in the facility (in weeks) as this calculation was determined to be the most feasible method given the available data. Similarly, given the data, the surface area was considered as a proxy for the healing rate. However, wounds can be measured by their depth in addition to their surface area. Thus, the method of characterizing wound healing by measuring wound surface area limits its applicability in more advanced-stage pressure injuries that may not necessarily have more surface area but may have more depth. Furthermore, it would be difficult to analyze any psychological issues including anxiety and depression that may be associated with pressure injuries. Since these conditions are assessed using specific techniques, general medical records may not include the necessary data for a more detailed retrospective analysis of such conditions. Lastly, the factors compared in this study are not comprehensive, and specifically, the wound care regimen was not assessed. Further research may include a prospective cohort study design that consists of tracking weekly measurements of wound area and depth to better understand factors involved in wound healing.

This study attempts to address the knowledge gap present for pressure injury ulcers characterized by location in the transitional care setting. Like other studies, our research examined parameters typically associated with wound healing such as patient comorbidities, lab values, and demographics. In the group of patients studied, wound healing for all locations was associated with older age, female sex, and lower rates of paralysis and osteomyelitis. For all pressure injuries, healing in all locations was also associated with a smaller mean initial wound surface area, depth, stage, and a significantly decreased length of transitional care stay. Statistically significant associations with the healing of sacral wounds include initial wound surface area, depth, and stage. Statistically significant associations with healing for both ischial and trochanteric wounds include initial surface area and stage, and initial depth and stage, respectively. For all pressure injuries, statistically significant associations with healing include reduced rates of paralysis and osteomyelitis. A statistically significant association with the healing of ischial wounds is present with hemoglobin levels, and statistically significant associations with the non-healing of sacral wounds are present with active osteomyelitis and end-stage renal disease requiring dialysis. Even though tools exist for risk assessment in pressure injuries, factors that have been correlated with delayed wound healing should be further evaluated when treating patients having sacral, ischial, and trochanteric injuries in the transitional care setting. Although the factors that affect wound healing including increased wound surface area and depth would generally be expected to be correlated with delayed wound healing, more attention could be directed to patients with paralysis, active osteomyelitis, end-stage renal disease, or lower hemoglobin, depending on the pressure injury location.

CONCLUSIONS

Our study suggests that wound-related characteristics, variable by anatomic location, typically correlate with wound healing and are generally more predictive than lab values and multiple patient comorbidities. Analysis of the data further shows that the presence of specific comorbidities including paralysis and osteomyelitis has a negative impact on wound healing across all locations. For sacral wounds, comorbidities including dialysis dependence and osteomyelitis were associated with poor healing. For ischial wounds, a higher hemoglobin level was significant in predicting wound healing. Overall, it is recommended that the primary factors associated with delayed wound healing including wound location, larger initial wound surface area, depth, advanced stage, age, sex, paralysis, osteomyelitis, end-stage renal disease, and anemia be carefully evaluated to identify patients who are vulnerable to delayed wound healing to provide effective management of pressure injuries in the transitional care setting.

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Conflicts of Interest
The authors report no conflict of interest.

Ethics Statement
This study was approved by the University of Virginia Institutional Review Board.

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DEMOGRAPHIC ANALYSIS OF LUNG CANCER SCREENED POPULATION: AN INSTITUTIONAL EXPERIENCE

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ABSTRACT

Purpose
Lung cancer is the leading cause of cancer-related deaths in the United States. Racial and ethnic disparities exist across all aspects of lung cancer diagnosis and treatment. The purpose of this study was to characterize the demographics of patients who underwent lung cancer screening (LCS) at the University of Virginia (UVA) and compare them to patients who are current tobacco users but not screened.

Methods
Data was obtained from UVA's LCS program dataset. Descriptive statistics were analyzed using Kruskal-Wallis test, two-sample t-test, and chi-squared test for demographic data.

Results
Between 2014 and 2022, a total of 2,173 patients underwent LCS. Of these, 978 (45.01%) were female, 1,194 (54.95%) were male, and 1 (0.05%) identified as non-binary. The median age at first screening was 62 (IQR = 9). Race, ethnicity, and insurance status were significantly associated with pack-year history ($p < 0.001$, 0.038, and < 0.001, respectively). The LCS population had a significantly lower proportion of Hispanic/Latinx patients compared to a group of current tobacco users not screened ($p < 0.001$).

Conclusions
This study characterized the demographics of patients in UVA's LCS program, which will guide future analysis of social determinants of health and create solutions with a focus on African American and Hispanic/Latinx patient populations.

INTRODUCTION

Lung cancer is the leading cause of cancer-related deaths worldwide, in the United States, and in Virginia [1–3]. Furthermore, the majority of lung cancers are diagnosed at an advanced stage [1]. Much of the evidence surrounding the implementation of preventative lung cancer screening (LCS) arises from the National Lung Screening Trial (NLST), which showed significant reductions in the absolute risk of lung cancer death and all-cause mortality for patients undergoing LCS via low-dose CT scan [1]. As of 2022, LCS eligibility criteria by the U.S Preventive Services Taskforce (USPSTF) includes adults aged 50 to 80 years with a 20 pack-year smoking history who currently smoke or have quit within the past 15 years [4].

Under these criteria, approximately eight million adults in the US are eligible for LCS [5]. However, only 5.7% of patients at high risk have undergone LCS in 2021 nationwide and 8% in Virginia.2 Barriers to screening include clinical challenges in identifying patients eligible for screening based on tobacco use history, low primary care provider referral rates, lack of access to health insurance and concerns about health insurance coverage, and lack of access to low dose CT scanners [6]. Furthermore, significant racial and ethnic disparities exist across all aspects of lung cancer diagnosis and treatment including insurance status, timing of diagnosis, treatment via surgery or other methods, and survival [2]. In 2021, patients in the U.S. who identified as Hispanic/Latinx were 16% less likely to have an early diagnosis, 26% more likely to not receive any treatment, and 16% less likely to survive five years, compared to patients identified as white [2].

Given the disparity in access to lung cancer screening at both the national and state level, the purpose of this study was to investigate and characterize the LCS population in UVA-served areas to examine areas of racial and ethnic disparities to identify best avenues for improved patient enrollment. We also compared the LCS population to the population of current smokers but not screened (as a proxy for patients who qualified for LCS but were not screened due to data availability) in order to determine any disproportionate underrepresentation of certain patient groups.

METHODS

The University of Virginia's institutional LCS program was implemented in 2014, shortly after specific eligibility criteria for LCS were recommended by the USPSTF in 2013. The program is run jointly by the Department of Radiology and Medical Imaging and the Emily Couric Clinical Cancer Center. The program engages patients residing in areas served by the institution, including the City of Charlottesville, Albemarle County, and surrounding counties. Screening locations include Charlottesville, Buchanan County (RCF – Buchanan General Hospital), Louisa County (UVA Medical Park Zion Crossroads), and Buckingham (peripheral units). Patients are typically referred to the program by their primary care providers, both within and outside of UVA. Other pathways to the LCS program include self-referral and referrals from the institutional Tobacco Treatment and Cessation program. Currently implemented and developing strategies to reach patients include an email newsletter, patient facing rack card in radiology waiting rooms and community events, awareness events, and electronic advertisements in various areas in the UVA hospital.

Data were obtained from UVA's LCS program dataset, which reports to the American College of Radiology National LCS Registry, for patients enrolled from 2014 to 2022. Gender, race, ethnicity, and age at first screening were obtained for each patient. Variable distributions were reported as median/IQR. Median age at first screening stratified by race/ethnicity was analyzed with the Kruskal-Wallis test. Comparisons between this study's screened population and the population of current tobacco users who were not screened (obtained via data pull from the electronic medical record) were performed using the two-sample t-test and chi-squared test. Information not available in the medical record was documented as "unknown." Statistical significance was set to $p = 0.05$. Data analyses were performed using R (4.0.3, R Core Team, 2020).

RESULTS

A total of 2,173 patients underwent lung cancer screening at UVA from 2014 to 2022. Of these, 978 (45.01%) were female, 1,194 (54.95%) were male, and 1 (0.05%) was non-binary (Figure 2a). Of the studied sample, 1 (0.05%) patient was American Indian or Alaska Native, 7 (0.32%) were Asian, 370 (17.03%) were Black or African American, 1,761 (81.04%) were White or Caucasian, 1 (0.05%) was White or Caucasian and American Indian or Alaska Native, 30 (1.38%) were Other Race, 1 (0.05%) was Other Race and White or Caucasian, and 2 (0.09%) were unknown (Figure 2b). Among ethnicity, 15 (0.69%) patients were identified as Hispanic or Latinx, 2,131 (98.07%) were identified as Not Hispanic or Latinx, and 27 (1.24%) unknown (Figure 2c).

The median age at first screening was 62 (IQR = 9) (Figure 2d). The distribution of median age at first screening stratified by race and ethnicity was further analyzed (Figure 1). There were no statistically significant differences of median age at first screening across race ($p = 0.264$) or ethnicity ($p = 0.408$). There was a statistically significant association between the number of pack-years stratified by patient race (Figure 2a, $p < 0.001$). Hispanic or Latinx patients receiving their first screening had a lower median pack-year history of 40 compared to non-Hispanic or Latinx patients who had a higher median pack-year history of 45 (Figure 2b, $p = 0.038$). Furthermore, insurance status was significantly associated with pack-years (Figure 2c, $p < 0.001$). Patients enrolled in UVA's payment assistance program had the lowest pack-year history at 40, while patients with Medicare had the highest at 48.

We additionally compared the LCS population to the population of current tobacco users as a proxy for patients eligible for LCS but not screened. The proxy was used due to data availability reasons. The LCS population were more likely to be older, with a mean age of 62.91 years compared to current tobacco users (61.12 years) (Figure 3a, $p < 0.001$). The LCS population did not differ significantly in gender distribution (Figure 3b, $p = 0.144$) or patient race (Figure 3c, $p < 0.001$) compared to current tobacco users (Figure 3b, $p = 0.144$). Furthermore, the LCS population had a significantly different distribution of patient ethnicity, with decreased representation of Hispanic or Latinx patients compared to current tobacco users at 0.7% and 1.72%, respectively (Figure 3d, $p < 0.001$).

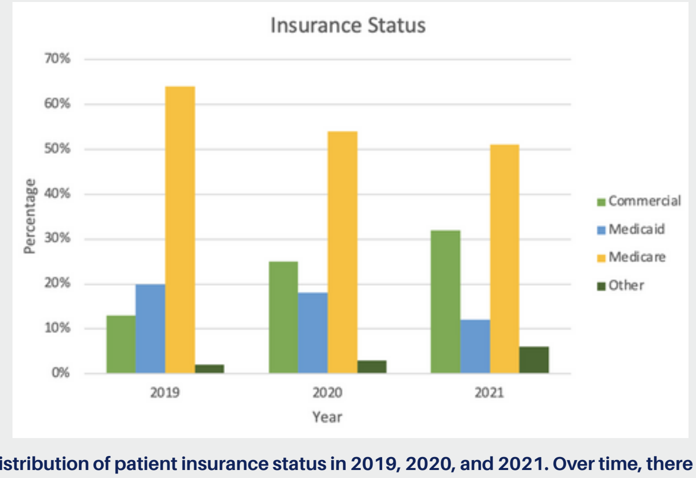

Figure 1. Distribution of patient insurance status in 2019, 2020, and 2021. Over time, there has been a decreasing percentage of individuals with Medicare coverage and increasing percentage with commercial coverage.

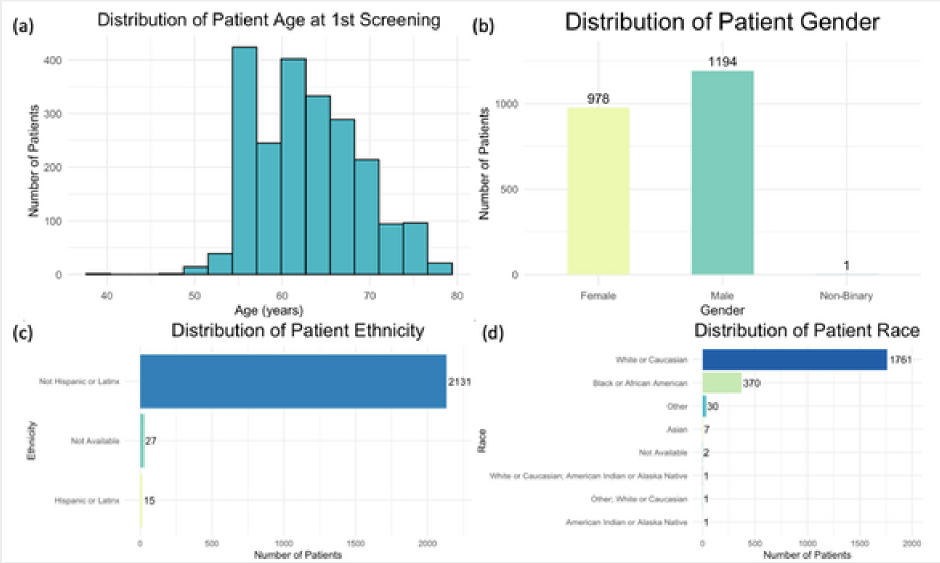

Figure 2. Demographics distribution of LCS population. Distribution of (a) gender, (b) race, (c) ethnicity, and (d) age at first lung cancer screening.

DISCUSSION

These results characterized the demographics of patients who have undergone LCS at UVA since the inception of its LCS program in 2014. There was a lower representation of females, a significantly lower representation of non-White or Caucasian patients, and a significantly lower representation of Hispanic/Latinx patients. In the area that UVA serves, 6% of the population identified as Hispanic/Latinx [7], while this population comprised less than 1% of LCS patients. Furthermore, the demographics distribution of Virginia was 60% White or Caucasian (non-Hispanic/Latinx), 10% Hispanic or Latinx, and 20% African American (non-Hispanic/Latinx) [8]. There were significant associations between pack-year history and race, ethnicity, and insurance status. Furthermore, the LCS population differs demographically from the population of current tobacco users not in the screening program. Specifically, there was a lower representation of Hispanic/Latinx patients, using current tobacco users as a proxy for patients eligible for LCS but not screened. This demographics analysis helped to analyze specific social determinants of health which may impact access to LCS.

In terms of insurance coverage, LCS was fully covered by Medicare, Medicaid, and most commercial carriers for patients who are eligible. The insurance status in the LCS program had changed over the last 3 years (Figure 1), reflecting the modifications in regulations of insurances over time. Notably, there had been an expansion of coverage through commercial insurance plans due to policy adjustments at the national level.

Prior studies have examined barriers to LCS among Hispanic/Latinx patients, many of which are also reflected in the LCS-eligible population as whole, including: financial costs and concerns about insurance coverage, fatalistic beliefs about LCS, fear of radiation exposure, and anxiety related to CT scans [9]. Other factors noted as barriers to preventative cancer screening included logistics of attending and navigating appointments, transportation access and distance from the LCS center [9], geographic isolation and rural areas, provider bias, limited English proficiency, immigration status [10], low socioeconomic status or poverty [11], and low health literacy and/or education level [12].

A major limiting factor in the analysis was missing data. Many patients did not have adequate smoking history recorded in the electronic health record, which limited identification of those eligible for screening and therefore analysis involving comparison of those eligible who did and did not undergo LCS. Inadequate smoking history documentation is a nationwide issue for LCS [13–16]. Furthermore, the health record included designated sections for recording social determinants of health like transportation access, food insecurity, education, and economic stability. This information was frequently captured in a non-systematic manner as part of the medical history. Consequently, the data collection practices within clinical notes substantially restricted access to such information. The lack of standardized data elements, assessment tools, and measurable inputs regarding social determinants of health is a major limitation in the research of population health [17]. Using the population of current tobacco users who were not screened as a proxy for those eligible for LCS was also limited in that the former did not account for age, pack-years, or patients who had already quit using tobacco, which were all factors that were accounted for in LCS eligibility.

Understanding the demographics of UVA's patient population and the main limitations to appropriate access to screening care is the first step to create and implement targeted outreach strategies. The study's overall goal was to increase awareness about the disparities in lung cancer screening in the local community and thus screening rates in specific populations who are currently underrepresented at UVA. In the future, this could hopefully improve lung cancer-related morbidity and mortality, with specific emphasis on our Hispanic/Latinx patient population. Prior interventions at other institutions for both lung and other cancers have cited community-based interventions, addressing health literacy and health system navigation, easing logistics of attending appointments, and outreach to primary care providers as particularly helpful in the success of LCS outreach [11,18,19].

Given that this work has established the need for an intervention, a community-centered approach with outreach to and through existing community organizations, development of targeted marketing and advertising, and creation of multilingual materials to increase engagement with the local patient population are some future strategies that could improve patient representation and health equity. Future research is needed to evaluate the success of these potential programs in improving healthcare access.

Conflicts of Interest
The authors report no conflict of interest.

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ANALYZING PUBLIC AWARENESS OF ALOPECIA THROUGH GOOGLE TRENDS AND SOCIAL MEDIA IN THE UNITED STATES FROM 2004 TO 2022

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ABSTRACT

Alopecia areata is a common medical condition, affecting roughly 2% of the global population, that characteristically causes patchy, circular hair loss. As 93% of Americans report using the internet to obtain health information, we analyzed Google Trends and Instagram to examine public interest in alopecia given its recent rise in media attention. We conducted a Google Trends search with the keyword “alopecia”. Public interest was analyzed using relative search volume (RSV), showing temporal and geographic trends. The top 300 Instagram posts with the hashtag “alopecia” were characterized by source and theme. Google Trends search yielded 290 million results, with increasing volume between 2004 and 2022 (Figure 1). Prior to 2022, themes centered around alopecia etiology, particularly in women (Figure 2). Following the 2022 Oscars, terms centered around Jada Pinkett-Smith, an American actress and talk show host with alopecia areata. The source of most Instagram posts were from patients (42.7%) or hair stylists (18.7%). Common Instagram themes included treatments (42.7%), personal stories (41%), and modeling (13%) (Figure 3). Google Trends provides an overview of population interest in alopecia while Instagram highlights common themes. Alopecia was disproportionately queried by women, consistent with known public stigmatization. Stigma may negatively impact awareness and make it more difficult for women to obtain hair loss resources. We saw that celebrities play a prominent role in public interest and awareness of alopecia. Our Instagram sample showed predominance of posts pertaining to treatments for alopecia from patients with few posts from healthcare professionals. In summary, increased awareness regarding alopecia in social media is needed, highlighting an opportunity for clinicians to expand their educational scope.

INTRODUCTION

Alopecia areata is a common medical condition affecting roughly 2% of the global population [1] that characteristically causes patchy, circular hair loss. It is associated with social stigmatization, particularly in women [2], conferring a disproportionately severe psychological and social burden on patients’ quality of life despite its benign clinical course. As of 2021, 93% of Americans report using the internet and nearly half report using social media to obtain health information [3, 4]. Google and Instagram are two of the major online platforms, with 3.5 and 2 billion users, respectively [5, 6]. Given increasing reliance on these platforms to obtain health information, our objective was to examine temporal trends, primary audiences, and other noteworthy points regarding public awareness and interest in alopecia through analyzing Google Trends and Instagram data. We hypothesized that public awareness and interest has quantitatively increased over the past two decades given its recent perceived rise in media attention. In particular, we hypothesized a quantitative increase in social media coverage following the 2022 Oscars featuring Jada Pinkett-Smith, an American actress and talk show host who has famously been diagnosed with alopecia.

METHODS

Google Trends is an open-access database beginning in 2004 that shows how frequently a single search term is entered into Google’s search engine relative to the site’s total volume over a specific timeframe. As only one search term or phrase can be entered, a Google Trends search with the keyword “alopecia” was performed on August 9, 2022. Public interest in alopecia was analyzed using relative search volume (RSV) and top queries for alopecia. RSV shows temporal and geographic trends of searches while normalizing for population sizes on a scale of 0-100. The top 300 Instagram posts as of August 9, 2022 with the hashtag “alopecia” were characterized for source of information and themes [7]. Source and themes were coded by two independent authors and determined by author consensus.

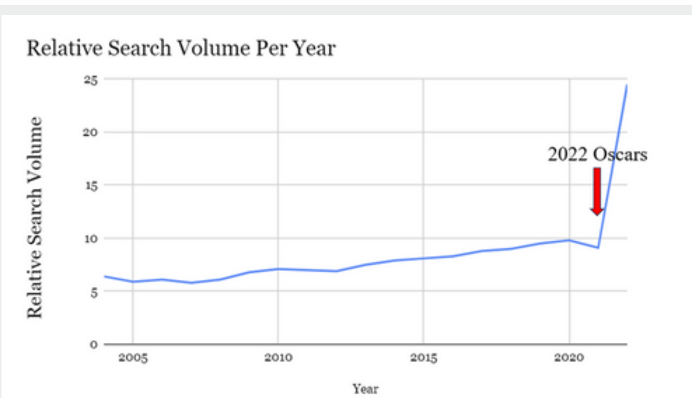

Figure 1: Relative search volume (RSV) per year by Google Trends related to the search term “alopecia”, as of August 9, 2022. As described above, RSV shows temporal and geographic trends of searches while normalizing for population sizes, and functions as a proxy for search volume.

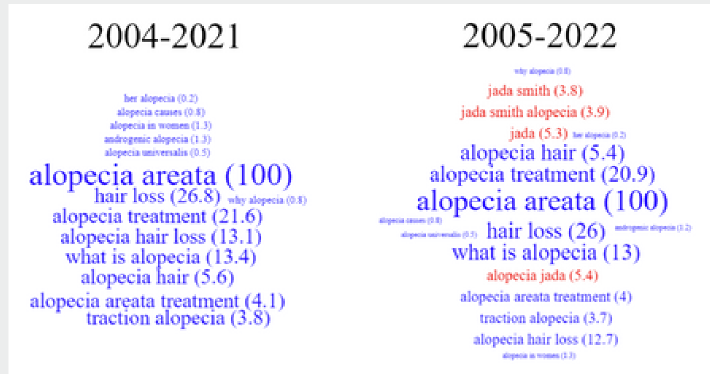

Figure 2: Word cloud of the top Google Trends queries for alopecia between 2004-2021 (left) and 2004-2022 (right). Terms highlighted in blue reflect those most popular between 2004-2021 while those in red represent the subset of newly popular terms from 2021-2022. Words that were searched in higher frequency are indicated through larger font sizes as well as RSV count in parentheses.

RESULTS

The Google Trends search yielded 290 million results, with increasing volume since 2004 (Figure 1). The top alopecia search results were from the following pages: WebMD, American Academy of Dermatology, Mayo Clinic, National Institutes of Health, Yale Medicine, National Alopecia Areata Foundation, and Wikipedia. Prior to 2022, the most popular themes centered on alopecia etiology, particularly in women (Figure 2). Following 2022, notably around the Oscars, the most popular search terms centered on Jada Pinkett-Smith. Search frequency has increased since 2004 (RSV 6.4, Figure 1) with peaks in 2020 (RSV 9.8) and 2022 (RSV 24.5).

The majority of Instagram posts were from patients (42.7%) or hair stylists (18.7%). The top three most common Instagram themes included treatments (42.7%), personal stories (41%), and modeling/media representation (13%) (Figure 3).

DISCUSSION

Google Trends provides a broad overview of population interest in alopecia while Instagram offers a snapshot of popular social media themes. RSV trends show that interest in alopecia has increased over the past two decades. Our data suggests that celebrities such as Jada Pinkett-Smith play a prominent role in the increased media coverage and interest regarding alopecia. Furthermore, many of these Google searches, as seen in Figure 2, specifically queried alopecia in women. Notably, the stigma associated with alopecia has been shown to be more severe for women [2]. Increased stigma may negatively impact alopecia awareness and make it more difficult for women to obtain hair loss resources, as reflected by an overall rise in searches for alopecia following increased media attention. The most prevalent content within our Instagram sample included discussion of treatment options and personal stories from patients or hair stylists. In contrast, none of the top Google searches related to the search term “alopecia” involved specific treatments for alopecia, instead focusing on etiology or general treatment inquiries. This may be because a majority of Google users are not aware of specific treatments for alopecia as compared to Instagram posts, who were mostly either patients or hair stylists. Notably, only a small percentage (9%) of the top Instagram content came from medical professionals. This may represent an opportunity for clinicians to expand their scope on social media and use it as an opportunity to improve patient care and education.

It is crucial for clinicians of all specialties to have a strong understanding of alopecia’s etiology, prevalence, treatment, and biopsychosocial impact on patients’ lives, as this enables clinicians to best understand patients’ perspectives, goals, and concerns. Beyond this, establishing a stronger social media presence on widely used platforms, such as Instagram, Facebook, and TikTok, assembling community engagement projects, and offering pamphlets and other resources can help patients feel understood as well as find effective treatment. Importantly, establishing a stronger healthcare social media presence can improve the quality of information available to patients online, particularly younger patients. Healthcare professionals have received formal clinical training and likely have fewer incentives to selectively curate information than stylists and business owners, both of whom comprised a greater proportion of Instagram posters.

Recently, a similar study on social media trends regarding alopecia areata was published by Gupta et al. [8]. We feel that our study effectively complements theirs. Both our study and theirs used Google Trends, choosing different search terms. We elected to choose “alopecia” as opposed to the more detailed terms in the study by Gupta et al. as many patients may be more familiar with the term “alopecia” than “alopecia areata” and “pattern

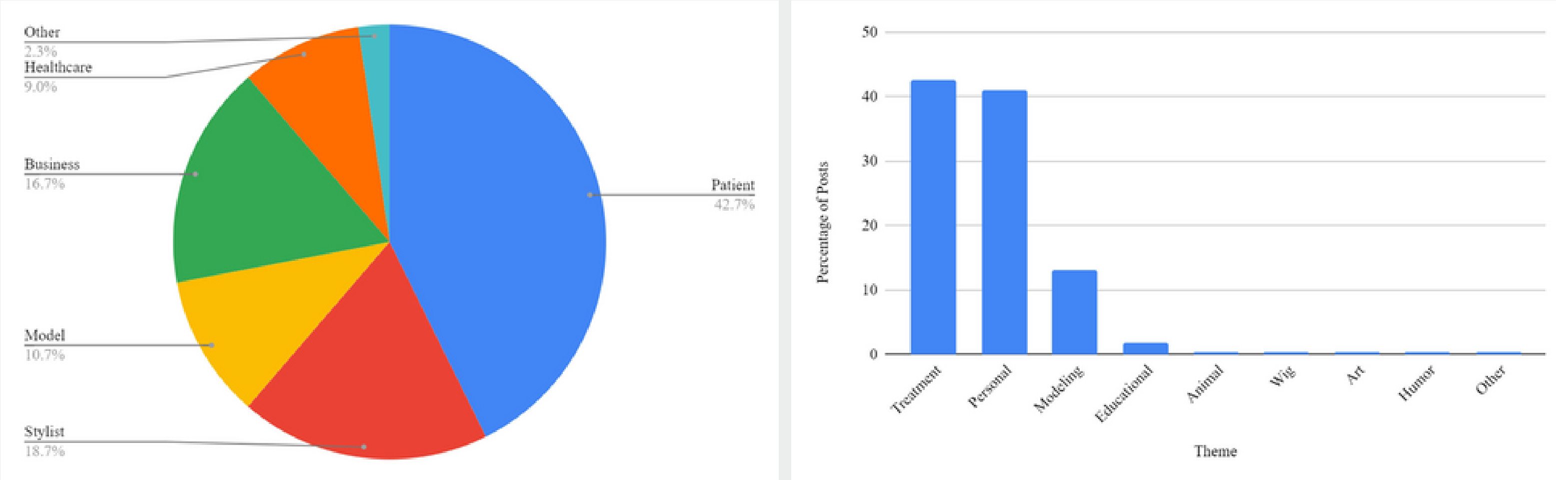

Figure 3: Instagram post distribution by creator (left) and theme (right). The top 300 Instagram posts as of August 9, 2022 with the hashtag "alopecia" were characterized for source of information and theme by author consensus. The most common creators were patients, stylists, and businesses. The most common themes were treatment, personal, and modeling.

hair loss", which are less frequently used by individuals outside of healthcare, business, or styling. Although we feel that the term "alopecia" may better encapsulate general population trends, one limitation of this approach is that "alopecia" refers to hair loss of any etiology, including hormonal (androgenetic alopecia), autoimmune (alopecia aerate), and malignancy-associated alopecia, not just alopecia areata. While both our study and theirs saw a spike in RSV in 2022, we attributed ours to the 2022 Oscars while they attributed it to the FDA approval of Olumiant, a newly approved drug to treat alopecia areata in individuals over 1 years of age. This may be due to the difference in search terms used. Although the incidence of alopecia areata has increased over time from 2.0% in 2016 to 2.2% in 2019 [9], this alone is unlikely to explain the spike in RSV.

Additionally, Gupta et al. focused on TikTok and YouTube, while we chose to focus on Instagram. Both platforms have a wide range of audiences, making them good choices for analyzing population trends. TikTok and YouTube primarily contain videos of varying lengths, while Instagram primarily contains images with captions.

A limitation of this study is that only 2 online platforms, Google Trends and Instagram, were studied. A possible future direction is to expand this study to other social media platforms, such as Twitter and Facebook. Google Trends provides population level data on public interest in a search term and is limited in its application to individual patients. Conversely, data from Instagram is more individualized, as themes and sources of data can be characterized, but difficult to amalgamate. As Instagram does not offer accessible metadata, sources and themes were coded by author consensus, which is inherently subjective. Although 9% of posters claimed to be healthcare workers, there was no way to verify their identity through Instagram.

In summary, increased awareness regarding alopecia in social media is needed, highlighting an opportunity for clinicians to expand their educational scope and decrease the stigma associated with alopecia, especially for women [4, 6].

Conflicts of Interest
The authors report no conflict of interest.

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EVALUATING A NOVEL COMPUTER VISION FALL DETECTION SYSTEM IN A SIMULATED CLINICAL SETTING

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ABSTRACT

Background
Falls are the leading cause of accidental injury and death in the United States among older adults. Reliable fall detection systems offer the potential to improve quality of life and reduce health system costs. In this study, an automated video-monitoring and computer vision system designed to detect falls was evaluated in a controlled, simulated clinical environment.

Methods
Twenty-seven adult participants performed eight simulation scenarios, consisting of sitting, standing, falling, and other common movement patterns. Each scenario was performed five times in a randomized order. Scenarios were recorded by a video capture system of three camera angles and analyzed post hoc by computer vision software. Accuracy, sensitivity, and specificity of the system to properly identify falls were calculated. Analysis was performed both at the level of three individual cameras ("camera") and a compiled three-camera system ("system").

Results
In properly identifying fall scenarios, the system had an accuracy of 87.9% (sensitivity 98.0%, specificity 81.8%). Cameras ranged in accuracy from 87.8% to 88.7% (sensitivity 78.1% to 86.8%, specificity 88.5% to 94.1%). For missed falls, the compiled system detected motion in all scenarios. For false positives detected by the system, 68.7% were attributable to one scenario in which participants sat on the floor.

Conclusions
Fall detection is critical in the care of older adults. This study demonstrated the pre-clinical viability of a three-camera computer vision system to identify falls in a simulated clinical setting. Future studies should focus on further testing in various environments and real-time analysis to send alerts to healthcare professionals.

INTRODUCTION

Falls are a serious threat to the health and well-being of older adults and pose a significant public health challenge for early recognition and prevention efforts. Falls represent the leading cause of accidental injury and death in the United States among adults over the age of 65 [1]. It is estimated that approximately 25% of older adults experience at least one fall annually [2]. This is of particular relevance today, as the Centers for Disease Control and Prevention (CDC) predict nearly a 40% increase in the number of falls between 2018 and 2030 due to aging of the U.S. population [3]. Falls are quite common in a variety of patient-care settings including hospitals, nursing homes, and assisted living facilities. Recent statistics in the United States suggest that approximately 700,000 recorded falls occur annually in hospitals [4] Additionally, over 800,000 residents in nursing homes experience a fall. Independent of comorbidities, nursing home residents are particularly prone to experience repeated falls [5].

In addition to physical consequences of falls such as hip fractures, head trauma, and subsequent risks of surgery and/or hospitalization [6, 7], the fear of potential falls leads to many negative psychological and physiological effects in vulnerable populations. Adults with fall anxiety may participate in less physical activity, which may lead to a decreased quality of life and further deconditioning [8]. This is particularly concerning since one of the strongest predictors for falls is a history of prior falls, perpetuating a cycle of falling in susceptible patients [9]. Many older adults do not report falls to their healthcare professionals, preventing the design and implementation of effective fall interventions [10].

Falls also have important economic consequences. In 2015, the total medical costs associated with falls exceeded $50 billion in the United States,11 making falls one of the top 20 most expensive medical conditions in the U.S.12 Costs are expected to continue to increase drastically in the coming decade, with Houry et al. predicting the yearly cost of falls to reach $100 billion by 2030.13 Because death or serious injury from a fall while being treated in a healthcare facility is categorized by the Centers for Medicare and Medicaid Services (CMS) as a "never event," CMS does not reimburse hospitals for downstream costs associated with patient fall events. Essentially, health systems are financially accountable for the costs of patient falls.14 Among hospitalized patients in Australia, Morello et al. reported that patients who experienced a fall-related injury while hospitalized had an average increased length of stay of twelve days, and they incurred additional inpatient expenses totaling 11,396 Australian dollars or 10,710 U.S. dollars in 2022 when adjusting for inflation.15 With one of the major predisposing risk factors for falls being increased age,9 the physical and financial cost of falls can only be expected to increase since the U.S. Census Bureau estimates the population over the age of 65 will nearly double from 2016 to 2060.16 Therefore, the design and implementation of effective fall mitigation systems is imperative.

This study assessed the ability of an automated video-monitoring and computer vision software that applies object and pose detection programs to autonomously identify patient falls using multiple camera angles and a composite system. Specifically, this system's preclinical viability to correctly identify falls performed by healthy participants in a variety of common patient movement pattern scenarios was tested in a simulated clinical environment. Instances in which the technology failed to detect falls were further investigated to determine if the technology was still able to detect motion or completely failed to operate. We hypothesized that there would not be a significant difference in the accuracy across each individual camera angle but that the composite system would have the greatest sensitivity and lowest specificity in detecting falls.

METHODS

Fall Mitigation Software

The applied computer vision and fall mitigation software (FMS) functions by identifying and classifying all objects from captured frames in a camera's field of vision using a set of probabilities. When an object is identified as a person based on the classification probability, their pose is analyzed using pose detection algorithms that focus on anatomical landmarks. Next, the FMS records each object's history frame by frame and tracks a person's movement and environmental interactions relative to all other known objects. Within the context of pre-defined risk-factor parameters, such as movement velocity, rapid change in posture and anatomical landmarks, or a person's contact with the floor, the FMS can detect clinically relevant human movement such as sitting, standing, and falling by analyzing how objects and people's poses change over time (see Figure 1).

Figure 1: Information Flow Through Fall Mitigation Software (FMS) demonstrates the workflow of the falls algorithm. FMS first identifies objects and people and uses a pre-programmed ruleset and parameters based on movement velocity, abrupt change in anatomical landmarks, and a person's contact with the floor to identify falls.

Study Design

To assess the preclinical viability of the FMS in detecting falls in common human movement patterns, a clinical simulation study was conducted using healthy human participants. The protocol was approved by the University of Virginia Institutional Review Board for Health Sciences Research. Healthy adult participants without a history of movement impairments were recruited from a population of undergraduate and graduate students to perform movement scenarios of interest in a simulated hospital room. All participants were informed of the risks and benefits of participating in this study, and all participants gave their informed consent to participate. Participants performed eight distinct movement pattern scenarios, and standardized coaching was given to all participants to encourage realistic fall movements (see Table 1).

Table 1: All Tested Scenarios

Fall vs No Fall	Scenarios
Fall Scenarios	(1) Participant falls off the bed onto the floor
	(2) Participant falls off the bed onto the floor with a research associate in the room
	(3) Participant stands up and falls
No Fall Scenarios	(4) Participant sits up in the bed
	(5) Participant sits up in the bed with a research associate in the room
	(6) Participant stands up from the bed
	(7) Participant stands up and walks out of the room
	(8) Participant sits down on the floor

Falls were performed onto a large, padded mat on the floor to reasonably protect participants. Each of the scenarios began with the participant supine in the hospital bed and terminated when participants completed the action within each scenario. Each scenario was repeated five times in a pre-randomized order for a total of 40 scenarios per participant. Scenarios were conducted in a well-lit room with participants dressed in street clothes. No blankets, medical devices, or obstructing objects were present in the cameras' field of vision. Participants were video recorded by three cameras in different angles, which were strategically positioned to maximize video coverage (see Figure 2). Recorded videos were then analyzed by the FMS post hoc.

These eight scenarios were selected to assess the FMS in identifying falls in common human movement patterns [17]. Scenarios 2 and 5 included a research associate in the field of view to determine the capabilities of the technology when multiple people were present in the room. Scenario 8 was chosen to determine if the FMS could differentiate between a fall onto the floor and a sit on the floor.

STATISTICAL ANALYSIS

The percent accuracy, sensitivity, and specificity for fall detection for each individual camera ("camera") and the compiled three-camera system ("system") were calculated. If any of the three individual cameras detected a "fall event," this was recorded as a fall for the system. Given the relative clinical consequences of a false negative versus a false positive for fall detection, a one camera threshold was used to optimize sensitivity at the expense of specificity. Scenarios with false negatives for fall detection were further investigated to determine if the FMS detected human motion during these events or failed to detect anything. Statistical analyses were performed using IBM SPSS Statistics (Version: 28.0.1.1 [14]).

RESULTS

Twenty-seven participants (14 male and 13 female) from the ages of 19 to 30 performed eight scenarios five times each. We sought to collect 135 repetitions of each scenario for a total of 1,080 events. Certain scenarios for a few participants were not recorded by some camera angles due to hardware limitations and malfunction such as cameras not being properly connected to our closed network. Some of these malfunctions were detected live by researchers and immediately repeated, while some could not be. However, almost all events were captured by at least one camera angle. Camera angle A captured 955 events, camera angle B captured 1,028 events, camera angle C captured 998 events, and the compiled system captured 1,077 of the original 1,080 events and 4 additional fall events that were repeated due to malfunctions, yielding 1,081 total events.

Fall Detection of all Three Camera Angles and Compiled System
All scenarios were analyzed for fall detection, and only scenarios 1-3 contained falls. Perfect accuracy was defined as falls detected in all events of scenarios 1-3 and no falls detected in scenarios 4-8. Camera angle A had an accuracy of 88.7%, sensitivity of 80.6%, and specificity of 93.6%. Camera angle B had an accuracy of 87.8%, sensitivity of 86.8%, and specificity of 88.5%. Camera angle C had an accuracy of 88.1%, sensitivity of 78.1%, and specificity of 94.1%. For the compiled system of all three camera angles, a fall detected by at least one of the camera angles was counted as a fall. The system had a comparable accuracy of 87.9%, but it had the highest sensitivity of 98.0% and lowest specificity of 81.8%.

When looking at missed falls or false negatives, camera angle B and the compiled system detected motion in all the events that they missed falls. Camera angle A detected motion in 69/70 events in which it missed falls. Camera angle C detected motion in 75/82 events in which it missed falls. Thus, even when fall events were missed, the technology detected motion in most events. False negatives for fall detections were distributed across all three fall scenarios (Scenarios 1-3).

A significant portion of false positives occurred in scenario 8, in which a participant sits down on the floor. Out of 131 total false positives detected by the compiled system, 90 of these occurred in scenario 8. In addition, 90/135 events of scenario 8 were incorrectly detected as falls. Thus, a second calculation of metrics was calculated for each camera angle with scenario 8 removed. With scenario 8 removed, camera angle A has an accuracy of 90.8% and specificity of 98.5%. Camera angle B has an accuracy of 92.3% and specificity of 96.5%, and camera angle C has an accuracy of 89.8% and specificity of 98.6%. The compiled system has an accuracy of 95.7% and specificity of 93.9%. Sensitivities remained constant with this alteration.

Table 2: Fall Detection of Each Camera Angle and Compiled System

Scenarios	Camera Angle A	Camera Angle B	Camera Angle C	Compiled System
Fall off Bed (1)	103/122	114/131	93/127	135/138
Fall off with RA (2)	94/120	107/129	86/125	130/135
Stand and Fall (3)	94/119	114/126	114/123	133/133
Sit up in Bed (4)	120/120	128/129	124/124	134/135
Sit up in Bed with RA (5)	120/120	126/129	125/125	132/135
Stand up (6)	118/118	125/128	120/124	126/134
Stand and Walk (7)	112/119	115/126	122/125	115/136
Sit on Floor (8)	86/117	74/130	95/125	45/135
Accuracy	88.7%	87.8%	88.1%	87.9%
Sensitivity	80.6%	86.8%	78.1%	98.0%
Specificity	93.6%	88.5%	94.1%	81.8%

DISCUSSION

Principal Findings and Implications
Using an aggregate of all camera angles, the compiled system of the FMS had a sensitivity of 98% and specificity of 81.8% when testing for falls in all scenarios. Most false positives occurred when a patient sat down on the floor, suggesting the fall detection algorithm was unable to fully distinguish between participants falling on the ground versus sitting down on the ground. However, if a patient sits down on the ground, it might be recommended for a caregiver or healthcare provider to know this information and potentially treat this event as a fall, especially if this is abnormal behavior or if the patient is physically or mentally unable to rise. As anticipated, the highest sensitivity and lowest specificity were recognized when analyzing the system versus an individual camera. However, this may

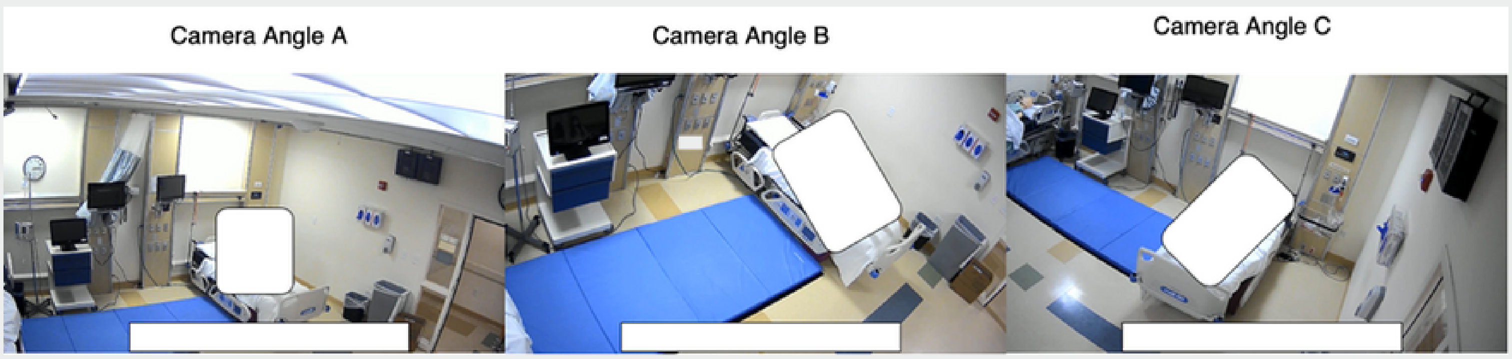

Figure 2: Camera Angles show the three angles of the cameras suspended from the ceiling used to record and analyze participants. Private information has been blocked out to protect participant identity.

be preferable clinically since the consequences of missing a real fall (false negative) are more serious than incorrectly detecting a fall when one did not occur (false positive).

Being older than 80 years old has been associated with an inability to get up after a fall, which makes older fall victims more likely to have more negative outcomes such as a decline in activities of daily living [18]. Brownsell et al [19] showed that older participants who used a fall detection device were able to perform their activities of daily living with improved confidence, due to the improved perception of safety provided by the detector. Furthermore, one of the greatest predictors of falls is a prior history of falling [9]. However, many older adults fail to report falls, despite this predicting a future fall [10,20]. Thus, an automated fall detection system that can provide confidence in older adults and accurately report falls to caregivers could have great utility in helping reach adults unable to get up and predict future falls. However, if this were to be incorporated into a clinical environment with real-time alerts for falls detected, this could contribute to alert fatigue and clinician burnout [21].

False negatives or events in which falls were missed were investigated to determine if the technology was still detecting motion in these events. Overall, each camera angle detected motion in either all or almost all missed fall events. Thus, future development on the technology could remove this disparity by lowering the velocity threshold needed to classify an event as a fall.

Currently, there are other available technologies to help mitigate falls, but they have demonstrated suboptimal clinical effectiveness demonstrated by the health and financial costs that accidental falls still result in today. Popular fall detection systems include wearable devices with embedded accelerometers and alert buttons [22]. However, they are often uncomfortable and rely on user cognition to function [12], thus significantly limiting user compliance among older adults with neurocognitive decline [22]. In addition to wearables, context-aware systems that integrate data from ambient devices such as floor sensors, infrared sensors, microphones, and pressure sensors similar to bed alarms are options to mitigate falls [23, 24]. However, bed alarms do not necessarily detect falls but rather detect motion off the bed, resulting in frequent false alarms. Video monitoring systems have been implemented in patient care settings to help decrease fall rates and false alerts in older adults [25]. The main disadvantage of these video-monitoring systems is the need to employ a human observer and thus the subsequent lack of patient privacy. The FMS could eliminate the need for a human observer via automatically monitoring the patient and sending alerts such as pages to providers to further help reduce costs and allow healthcare professionals to perform other duties.

Limitations
This study had several limitations. While no events were lost to software malfunctions, a minority of events for each camera angle were lost due to hardware difficulties and simulation center availability. Additionally, the scenarios studied were conducted in a well-lit hospital room environment when falls have been shown to occur in nursing homes and in bedrooms, bathrooms, and on stairs.5, 26 Furthermore, since this was the first time this novel system has been formally tested, only 27 healthy adult participants from an undergraduate and graduate student population from the ages of 19 to 30 were enrolled to minimize any chance of participant injury. These results may not be generalizable to the population over the age of 65 nor those with any movement impairments. However, the idea of simulating falls in these patient populations is concerning.

Future research should focus on testing the software's ability to detect falls in various environments with different lighting and color combinations between a participant's clothing and the color of the background and floor. More complex scenarios such as having other people enter and leave the room repeatedly to help simulate hospital rooms should be tested. Furthermore, future work should test software capabilities in which camera views are occluded such as by furniture or situations in which part of a person's body is not completely in the camera frame. Once future work has tested the software's ability to detect falls in various environments and more complex scenarios as well as verified its ability to send alerts to caregivers or healthcare professionals, it should be studied in observational clinical settings to evaluate whether it can truly help mitigate falls in the real-world and in vulnerable populations.

CONCLUSION

Falls continue to be a serious threat to the health and wellbeing of older adults and pose a significant public health challenge. Fall mitigation interventions are emerging as an important component to the overall health of older adults. This study was an initial assessment of a novel computer vision software that autonomously detects falls in a simulated clinical setting. The future application of this technology is promising, with a 98% sensitivity in fall detection. However, before this technology can be used with patients in clinical settings, further research is required to determine its ability to detect falls in various environments in addition to evaluating its ability to perform analysis and send alerts in real-time to caregivers and healthcare professionals.

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WHY WE NEVER SAY IT'S QUIET

BY: ELO OKAH
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I was supposed to start my trauma call shift at 6:30 AM, but by 7:11, I was still wandering around the hospital trying to figure out where I was supposed to be. I couldn't find the call room, and the page I sent to the on-call resident hadn't gone through. The only thing keeping me from a full-on spiral was the fact that I'd checked ahead of time and realized that, by some stroke of luck, the resident on-call was someone I'd just spent two weeks with on vascular surgery. Chill guy. Solid vibes. I figured if no trauma pages had gone out yet and my own pager hadn't gone off, I probably wasn't in any real trouble.

When I finally found him, I discovered that he'd accidentally locked himself out of his office—again. I helped him get back in, just like I had once during our vascular surgery rotation. We both laughed, and just like that, the shift had officially begun.

I headed to the medical student call room, which was essentially a tiny bedroom with a bed, a desk, and a very strong smell of armpits. Still, it was my space for the next 24 hours. A consult came in for a pediatric appendectomy—my first emergent surgery. I wasn't expected to do much, but I scrubbed in, stood in the corner and watched.

After the case, I went to the cafeteria to get lunch, then made a detour to the linen department. I couldn't handle the smell of the sheets in the call room, so I replaced them. I wasn't sure where to put the old ones, so I left them outside the door and hoped that I wouldn't get in trouble for some reason. It made the room a little more bearable.

Around 12:45 PM, I texted my resident to ask if I could step out for a bit. I live just across the street, and the hospital felt unnervingly empty since it was a weekend. He said it was fine, so I ran home for snacks and a few minutes of fresh air. I spent a little time with my family, checked in, reset, and returned about half an hour later.

The afternoon crept by. For the most part, I stayed in the call room, studying and waiting, and tagging along for the occasional consults. My pager remained silent. At 6:34, I got a text from a classmate who had been on call the day before. She asked how things were going, and that was the moment I made the dreadful mistake: I told her it was quiet. Too quiet. I even said I was bored.

At 6:35 PM, my pager went off.

The alarm was loud and shrill, jarring enough to make me jump. I hadn't heard it go off before, and I wasn't prepared for how sharp it would be. It was our first trauma page of the day—an incoming motorcycle accident. I moved quickly but in a haze, unsure what to expect.

The trauma bay was already filling with people by the time I arrived. At least ten individuals were moving with practiced urgency. I stood near the back, mimicking the others by watching the overhead status board, hoping no one would notice that I was visibly shaking. A voice called out from down the hall that the stretcher was en route, and the energy in the room shifted. People moved into place. My resident saw me hovering in the background and called me forward.

"Elo," he said. "Come stand here."

He pulled me into the center of the room. Suddenly, I was completely exposed. I wasn't wearing a cap, gloves, or gown. My braids were uncovered. A couple of people in the room were wearing yellow isolation gowns—not sterile, but something—and I started panicking. Should I have been wearing something? Was I supposed to mask up? Glove up? A part of me was genuinely waiting for a charge nurse to pop out of nowhere and reprimand me. I kept glancing around, half-expecting someone to tell me I didn't belong there.

Then the patient was wheeled in.

He was unconscious, immobile, and covered in blood. His skin was the same shade as mine, and for a moment, I couldn't look away. All I could think about was a family member I'd lost in a car accident. I imagined this must've been what he looked like when they brought him in. The patient's face was so mangled, so swollen and broken, that I couldn't make out any features. It could've been anyone. It could've been him.

Someone dropped a metal container into a bin and the loud clang made me jump. I scanned the room, embarrassed, hoping no one noticed. But everyone was focused on the patient. Obviously.

My resident turned to me and asked, "Do you want to help with this?"

That simple question brought me back. I nodded and stepped forward. I knew I had to lock in.

After the trauma case, I realized I had left my ID in the call room in my daze to get to the trauma bay. My resident had to badge me in, a full-circle moment that made me smile even in the chaos.

The rest of the night blurred together. Around 7:30 PM, we responded to another motorcycle trauma. I felt a little more prepared this time—less like a deer in headlights. I knew where to stand, how to assist, and I was able to help transfer patients. Between cases, I reviewed trauma protocols with my resident and worked on consult notes.

Not long after, a motor vehicle accident came in. The driver had experienced a seizure while behind the wheel and had another during the roadside check. I stayed present, helped where I could, and followed along as the team coordinated care.

At some point before midnight, I managed a short nap, but I was up again by 3:00 AM for another call. Even though I was tired, I knew what to expect. I moved through the steps more smoothly, and by then, the fear had settled into something more like focus.

Around 5:00 AM, we got a page that a patient was about twenty minutes out. My shift was technically supposed to end at 6:00, but my resident looked at me and said, "Go home. If you stay, you'll be here for hours." So I did.

It was still dark outside, and a light drizzle had started. I didn't have an umbrella, but at that point, I didn't care. I was cold and tired, and thinking about everything I'd just seen.

Technically, it wasn't a full 24-hour shift. It started a bit late, I took a short break in the middle, and the resident let me out a bit early. But emotionally, I lived all of it. I stood in the trauma bay unsure of my place and found my footing by the end of the night. I learned what it means to stay present in the middle of chaos.

And I learned why we never say it's quiet.

FOUR O'CLOCK IN THE MORNING

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We didn't know much. Over the radio, we learned he had been found down in the corner of a stairwell. He was living in a facility somewhere. When they found him, he was in cardiac arrest and remained in cardiac arrest eighteen minutes later. Now, at four o'clock in the morning, the emergency department prepared for an incoming code. The emergency medicine resident hunched over the table, his right fist curled up against his nose and the crease of his lips, with his elbow bent, resting near the keyboard, and eyebrows furrowed. The attending physician laid back in her chair, eyes focused on the status board. We watched the countdown until arrival. Two minutes. I folded my legs underneath my desk as my left foot tapped the air. My mind drifted through the H's and T's of Advanced cardiac life support (ACLS), a handy mnemonic for the causes of cardiac arrest. Hypovolemia, hypothermia, hyperkalemia…I couldn't think of the others. He might have been an asthmatic, but I wasn't sure if I heard that right through the radio static. Severe asthma exacerbation, maybe? Hypoxia, another H-word. Soon, a crowd gathered outside the trauma bay and spilled into the hallway. I followed behind the resident and joined the others– pharmacists, nurses, doctors, technicians, even a chaplain stood there waiting. The expressions in the room were shared: stoic, yet confident, as if any lone person was preparing to be the hero in a matter of minutes, if so called upon.

The stretcher came barreling down the hallway like a haunted parade float. Four EMTs rushed alongside each corner, and a fifth EMT was nestled in the large crease of the patient, his knees folded between the patient's left arm and chest. Bent over with sweat budding on both temples, the EMT repeatedly compressed on the patient's exposed chest, which lay lifeless, exposed, and covered in thick black curls. His skin was the same tone as mine, I thought to myself. Brown like caramel. Once the stretcher was parallel with the bed in the trauma bay, the emergency medicine resident called from the foot of the bed, "ONE, TWO, THREE!" Arms reached out, strong and purposeful, to guide the patient from one bed to the other. Meanwhile, the attending physician looked at me and announced, "Sarah. You will start compressions first." I nodded, hiding any anxiety as far back in my throat as I could. I removed my student badge and stethoscope, and flipped my ponytail back so fast it slapped the base of my neck. I took a few deep breaths. Press hard, Sarah. I stepped up on the stool and began compressions.

I forced myself to be in the room when the doctor called the family to break the bad news. It was now five o'clock in the morning. The code ran for almost 40 minutes without spontaneous return of his circulation. My arms felt tired from pushing and my stomach was growling, though I felt no true interest in eating. I followed the emergency medicine resident to a quieter room down the hall. We entered a large room with windows overlooking the patients' rooms, separated by gray curtains. I pulled up a chair next to him and sat quietly for the next half hour. No one picked up for the first six calls. The doctor just cycled through the numbers on file: brother, sister, uncle…brother, sister, uncle. Then someone answered.

"Hello?"
"Hello, is this Mr. Johnson?"
"Yeah. Who is this?
"Hello, sir. This is Dr. Tanner. I'm sorry to be calling like this, but I am a doctor calling from Wybeck Hospital. I'm afraid I have some bad news about your brother. I just want to make sure you're in a safe place before I continue. Can you sit down somewhere?"
"Yeah, I'm sitting."
"I'm sorry to share that your brother passed away early this morning."

He screamed. Big, breathless screams echoed through the landline; screams that didn't care who was listening; screams that quieted the growling of my stomach; screams that made the doctor take off his glasses and put his face in his hands, close his eyes and sigh softly. I sat in the dimly lit room, listening to the screams, imagining my father's brother hearing the news of my father's passing, which only added to the crescendo of pain vibrating through the room. But I couldn't help it; the man looked too familiar; his skin was too close in shade. He could have been related, maybe, in some spin-off life.

Later, as I waited for the merciful offer to leave night shift early and crawl back into my bed, I reviewed the patient's chart. With sleepless brain fog, I scanned each note, intrigued by each new bit of information I read. His story was far more complex than assumed; the outpour of information in his medical chart informed the mystery of the found-down patient who arrived at four o'clock in the morning. I learned he was a severe asthmatic and had been hospitalized several times this year already, and even intubated once. I kept seeing the same string of words in social work notes: social determinants of health. He had been couch-surfing and had trouble refilling his inhaler prescriptions. He once left AMA because he had a job interview in the morning. He was out of breath from just walking his son to the bus stop.

This information was arguably more disturbing than the acute circumstances that led to the arrest. His inhaler nonadherence was not because he didn't care about his health, nor did he leave AMA after some peace-disturbing argument with medical staff. He needed to find a job, he needed to secure more stable housing. He needed to provide for his children. These things would take precedence over an inhaler refill for most; but unfortunately for him, these compounded social determinants of health brought him to his final day. For some deaths, you can blame the healthcare system: expensive treatments precluding one's ability to pay, family care doctors so sparse that receptionists can only offer dates next year, or emergency room wait times longer than cross country flights. But this man's death was not the fault of the healthcare system, albeit some variables likely played smaller roles. Rather, his death was the failure of the society in which we live, allowing the poor and marginalized communities to suffer the worst healthcare outcomes. Black communities are 30-percent more likely to be diagnosed with asthma, and three-times more likely to die from it.1 Additionally, many poor communities face higher rates of asthma-related hospitalizations and asthma-related mortality.2,3 Being Black and impoverished were risk factors in this patient's hospitalization and expiration, and no amount of epinephrine could reverse underlying inequality.

When I finally left the hospital at six o'clock in the morning, with the sun peeking its head out from beyond the mountains and the birds telling each other it's time to sing, I thought about the forgotten H's and T's. Perhaps we need to add another H-word, one more appropriate, more inceptive. Perhaps we need to add the worst H-word of all: Hardship.

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A MOMENT OF SILENCE BEFORE SURGERY

BY: ANDREW SCHMIDT
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I looked up from my phone to watch as Mr. B was wheeled into the OR. I could almost picture that, underneath the various peripheral lines, ECG wires, and pieces of tape holding his endotracheal tube in place, he was sleeping. As I began to help transfer him to the operating table, my eyes landed on his hands. His fingernails were well-trimmed. It was a curious thing to think about—who had groomed him so well? Was it his family? Perhaps a bedside nurse? I knew it couldn't have been him. After all, for the last several days, Mr. B had been categorized as brain-dead.

I had never observed an organ procurement before, however, one evening on the second week of my Transplant Surgery rotation, the fellow on service offered me the chance. I didn't know what to expect. Thus, I was surprised to find the OR being set up as if it were for an ordinary surgery. But, this wasn't ordinary. The patient was brain-dead, and his nails were well-trimmed.

The nurses and surgeons bustled about, jokes filling the room to hide the grim nature of the operation. After the patient was brought onto the table and secured, a time-out was called. Business as usual. Except, something different at the end: a moment of silence. The nurse read out an honorary statement dedicated to Mr. B's donation, to this great act of giving. And, for ten seconds, the room stood in silence, broken only by the rhythmic beeps of the heart monitor. I wondered at the paradox of a regular heartbeat in someone who by all legal definitions was dead.

Then, a great chasm was created on his front side, from the collarbone to the pelvis. I had never seen an incision so large; I felt like an extra in an 80's slasher movie. The room filled with smoke and the scent of charred tissue, the signature mark of the Bovie. A bone saw was brought out, and with four fell swoops it split the sternum, screeching all the while. The work was done quickly, and the abdominal contents were soon fully exposed. I was transported back to first-year anatomy lab, standing over my cadaver, identifying vessels and landmarks in my head. A moment of shame draped over my shoulders; it felt impersonal to view Mr. B as a specimen.

A call was made by the surgeon, "proceeding with cross-clamping!" From my perch at the head of the bed, I watched a new flurry of activity as the fellow went about clamping the hepatic vessels and aorta. It was gripping. I turned to check what the anesthesiologist was doing, only to notice he had left. Moments later, the patient's O_2 sats began to plummet, along with the pitch of the monitor's sounds. The heart rate and blood pressure crashed too, even as my own increased. I went to say something, but noticed no one else paying any mind as alarms began to blare from the monitors. "Why was no one panicking?" I wondered.

I realized then why we had the moment of silence. We were allowing Mr. B to pass away. Yet, that couldn't have been the correct terminology. He was brain-dead, which means he had already died, right? Was there any significance to this "second death?" Could we still say that any part of Mr. B was alive? How could we, with any accuracy, identify the exact moment that his soul passed from his body?

While my mind was stormy with considerations of life and death, the operation continued. Soon there was a newfound paleness in Mr. B's forehead, a telltale sign of his static circulation. The steady rise and fall of his chest became as still as a graveyard. Crushed ice was unceremoniously poured into the abdominal cavity to preserve the organs, and, in time, the liver and kidneys were extracted from the patient. I couldn't look away, with fascination and macabre tension battling for dominance. As the team worked on the back-table to trim the vital organs, I turned to look at the clock. I saw it was already 9:00pm. I left soon after.

The night seemed more substantial on the walk home. Winds whispered through the leaves, and I struggled to decipher my puzzling thoughts. I was a different person, wearing the same wrinkled scrubs, with some part of me gained or lost during the hours I bore witness. I used to think of death as a very final state of being: one moment you are here, and the next, you are somewhere else. But, that philosophy had perished. It had become more of a spectrum. The death of the mind, the death of the body, the death of the spirit—these now felt like distinct entities. The shadowy nature of death melted away under those pale OR lights.

As I lay in bed that night, I was comforted by the fact that Mr. B's death carried at least some form of silver lining: the second life that was gifted to the organ recipients. On the transplant service, I saw truly remarkable changes in patients after receiving a new liver or kidney. The fatigue they carried for months or years vanished overnight. Bilirubin and creatinine levels swan-dived into normal ranges within a matter of days. And, most importantly, gratitude and excitement about their future glowed so bright in their rooms. With a single procedure, the weight of the world had disappeared from their shoulders.

I have signed up to be an organ donor myself. I hope that my death can bring a second chance to someone else. And I hope that, in my final days, I'll have someone at my bedside to comfort me (and to keep my nails well-trimmed).

MIRACLES IN THE MICU

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As a new fourth year student, I believed that the year of clinical experience already under my belt would prepare me for my critical care rotation. And while I wasn't completely naïve, the MICU would go on to humble me for the next four weeks. Not just from the complexity of the cases or the intensity of the workflow; rather, the staggering nature of the emotional stakes that each story carried, that is what floored me numerous times. One such story sticks out.

On a Monday in my second week, Mrs. R arrived. She was a woman struck by a terrible stroke of luck: a diagnosis of metastatic renal cancer before the age of 50. She was here as an ED transfer for flank pain and was found to have a subcapsular hematoma, which progressed to hemorrhagic shock. As if that wasn't bad enough, her pulmonary hypertension and tumor thrombi extending all the way from her IVC into her RA made her a poor surgical candidate.

Clearly, she was very sick. I knew this walking into her room before morning rounds. My first glimpse seemed to confirm my suspicions: her skin was sallow, her breathing labored, eyes distant. But her voice was clear. And I was stricken by the fact that Mrs. R didn't seem scared. She was attentive, calm, and soft-spoken, even laughing at my shaky attempt of a joke. When I told her that we'd do our best to treat her, that she was in good hands, she believed it. She told me that her daughter's birthday was a week from today, and she only cared about making it till then.

In the coming days however, the circumstances only worsened, bad luck piling up like straws on a camel's back. Her hemorrhagic shock led to renal failure, and so we started CRRT. She continued to bleed into her abdomen despite the best efforts of our interventional radiologists, who, in a last-ditch effort, embolized her entire left kidney. We simply couldn't discern the source of bleedingOn subsequent morning exams, her abdomen became tighter and more distended, and she now required a dilaudid PCA to control her pain. To make matters worse, her oxygen requirement began to rise rapidly, from room air to low flow to high flow. We hypothesized that, because of her prolonged bed rest, new clots had formed in her lungs. Without a doubt, Mrs. R was the most ill patient I had cared for.

And so, the MICU team was caught in a standstill. Intervening on her coagulopathy imposed the risk of causing further hemorrhage, but doing nothing introduced the risk of more clots. Surgery wasn't an option. All we could do was transfuse her when her counts dropped too low, knowing that, eventually, she would develop abdominal compartment syndrome. This was assuming she wouldn't succumb to AHRF before that point. It was a bleak situation. Our hope was dwindling, and we knew we needed to communicate this with her. Thus began a series of Goals of Care discussions.

She listened quietly as we relayed the situation. We described how we couldn't pinpoint the exact source of her abdominal hemorrhage. And that her new oxygen requirement, now at 65L, was very concerning. I saw worry etched into the faces of all who stood solemnly around her bed, as still as statues. Her family had tearful eyes; they had been briefed on her severity outside of the room. After explanations ran their course, we broached the idea of notion of comfort care, though my composure only started to crumble once we said we were doubtful she'd make it to her daughter's birthday.

And Mrs. R remained composed. Nodding, she said, "God will get me through this, he makes miracles happen every day." I didn't know what to think. I admired her certainty, her faith that things would get better. Above an ocean of despair, her demeanor refused to sink. Yet I couldn't help but have doubts. Unlike the grim countenances that pace the halls with scrubs and stethoscopes, miracles appeared to be rare in the MICU.

That was on a Thursday, and the next two days flowed by like whispers, casting no ripples or wrinkles into our management plan (which at this point was largely palliative). More discussions were held, during which Mrs. R decided to become DNAR as a precaution. During those discussions, I'm ashamed to admit that I had already come to terms with Mrs. R's mortality; I predicted she would die.

Sunday, my day off, drifted by ever so slowly, and I must have checked her chart at least five times for updates. I hoped not to see the word "deceased." But when Monday arrived, she was still there, smiling and spending precious minutes with her beloved daughter.

Within the next week, a bewildering change in events occurred: Mrs. R began to get better. Her blood counts rose, her O2 requirement fell, and subjectively, she was improving. Soon enough, she was able to transfer out of the MICU to the Hem/Onc floor. And as I discovered a few weeks ago, she was discharged from the hospital to home health. It was astounding.

I was aware of the concept that physicians often struggle to predict patient outcomes. However, in the face of such immense illness, the question persisted: how could she live? My team, myself included, felt powerless to stop death's insidious advance. Nothing short of a miracle was needed here, and Mrs. R was indeed counting on one. But I found her faith to be the miracle itself. She, with no options except to wait and hope, showed no fear. I had prepared for the worst without hoping for the best, and that was my mistake: the abandonment of hope. If there's any lesson to carry onward, it's to keep hope close. I won't forget that.

GOALS OF CARE

BY: ROBERT CUTLER
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I walked in the room, rubbing my hands together, waiting for the foam to evaporate between my fingers. The space was cramped, with Jen sprawled on the bench and Bill pacing the room. Now the attending, the intern and the other medical student entered the room in front of me, so I ended up standing awkwardly, partially behind the curtain separating the two hospital beds. We all knew what we wanted to talk about, but nobody knew what to say first, or who should say it.

"Let's see, can we get some chairs?" asked Dr. Sadler, reaching over to unhook the folding chair from its place on the wall.

"Oh sorry! We kind of moved in." Bill, the son-in-law, snapped into action, hurriedly pulling a backpack and a T-shirt off the loveseat. Dr. Kowalczyk walked around the curtain and grabbed the other folding chair and set it down. I dodged, trying to be as out of the way as possible. I had stepped all the way out from behind the curtain, but now was standing in the middle of the room, with all the movement around me. I realized I was standing in the middle of the circle of chairs that had been assembled.

Dr. Sadler looked me in the eye and said, "Do you guys want to sit?" He was still holding the chair, slowly unfolding it. I said yes, obviously, but then realized I didn't know which seat was intended for me. As the least important person in the room, I should take the least desirable chair, if I sat at all, but I wasn't sure whether that was the folding chair he was holding or the loveseat. Still unsure, I tried my luck with the loveseat, figuring that with two medical students in the room, we might be best situated in the same spot together where nobody would confuse us for someone in the know. Cyrus and I sat together, both on the edge of our seat. Neither of us wanted to look too comfortable.

"I'm Dr. Sadler. I'm the attending physician, or the supervising doctor."

"I'm Dr. Kowalczyk, I'm the resident physician."

A pause. Our turn. Who speaks first?

"I'm Robert. I'm a medical student with the team."

"I'm Cyrus. Also a medical student. Nice to meet you."

Jen smiled, a little too big. "Nice to meet you too. So many chairs in one little room I guess."

A pause. We still hadn't decided who would talk first. Jen and Bill didn't seem to be planning on it.

"Well, Franklin, you're a part of this conversation, too," said Dr. Sadler. I noticed the circle included the foot of the bed, but Franklin looked far away. He didn't seem to hear.

A pause. Nobody knew who to look at. I noticed Franklin was watching a home improvement show on a TV high on the wall behind me. I wondered who had put it on.

"Well, the swallow study looked, well it looked good," said Dr. Sadler.

Something snapped in the room.

"Oh! Oh yeah, I was actually down there. That kind of changes our trajectory, doesn't it? We had kind of, you know, one idea, but now what do we do?" said Bill.

"Yeah, the swallow study, I wasn't really sure what to expect," said Jen.

Bill continued, "Interesting learning opportunity, I guess. The speech and language student was there too."

"Oh, so you got to hear them teach?" Dr. Sadler asked.

"Yeah, yeah it was kind of cool."

"Well, it does change a few things. Maybe, uh, Dr. Kowalczyk, do you feel comfortable leading this conversation?"

"Yeah, yeah I do–"

"Yeah, well, if you're prepared, why don't you go ahead."

A pause. Less intense.

Dr Kowalczyk started slowly. "So medically, he looks a lot better. He-"

Jen popped in, "He is! But then, this morning I told him it was April 28 and he said, 'Oh! Happy birthday to you then!' so I think he's still pretty confused."

Bill said something I didn't catch. Something about eating.

"And he just had some applesauce! And did great with it," Jen said.

I could see Dr. Kowalczyk recalibrating. "He seems a lot better to me… Would you agree that he looks better than when he came in?"

Bill and Jen both started talking, "Oh yes of course. Night and day. I mean, he was unresponsive for, what, 3 days? Now look at him."

"So, he's doing a lot better, and we've done most of the things that we would do for him medically. The question is, where does he go next? Where do we go from here?"

The couple shifted. "Well, like I said, the swallow study went well—and that's great! So I don't know what we do next anymore."

"You have a few options. There's rehab, or home with you. There's home health…."

"Well, I don't know about rehab. Like would it be rehab? We don't want him to live there forever. He had told us pretty explicitly he doesn't want something like that. But if we had a better idea of the prognosis…," said Jen.

Bill added, "Obviously we don't have that crystal ball, but I mean, do you have any idea?"

Dr. Kowalczyk looked to Dr. Sadler. Dr. Sadler cleared his throat "Well, if you're wanting to be sure he doesn't stay there, really, I think in terms of trajectory, we'd be looking at more of a hospice type situation. That would be a bridge to go home with you."

Bill cocked his head, "But with the swallow study going well… Is hospice still an option?"

"Oh, I really believe so. I'm not the one who makes the final assessment, but I think that's what we would realistically be looking at."

Relief swept over Bill and Jen's faces. They both visibly relaxed in their seats. I thought I might have seen a tear streak on Jen's cheek, but I think in reality, I just thought one should be there from movies I'd watched. Earlier, I had thought the tension had left the room. It hadn't. I took a deep breath, not realizing I'd been holding it in.

"I had no idea, I figured that with the swallow study…" Nobody moved, but I felt like everyone was exchanging hugs. Franklin was still far away, watching a man in a hard hat carry 2x4s into the garage. I couldn't be sure, but he looked like he might be listening.

As the doctors, the daughter, and the son-in-law were talking over some details, my eyes were on Franklin. His mouth was always open. I wondered if it was enough to dry him out. I could see it now: Dry Hospital Air versus Parkinson's. The ultimate showdown. Friday at 4 Eastern (3 Central). I returned to the room, feeling guilty for daydreaming about a completely ridiculous MMA style fight between the two things while we were having this kind of conversation. As I looked back to Bill, I thought maybe I saw Franklin smile at me. Almost like he was placing a bet on the fight.

"You know, we're pretty equipped for this, which is fortunate. Lots of people aren't." Bill rubbed the back of his neck. He and his wife, both nurses in the ER, were clearly much more comfortable than when we first walked in.

Dr. Sadler chuckled, "Absolutely, I mean, the amount of medical knowledge and training between the two of you…. I mean you're probably just thinking to yourselves 'Wow, just one patient? Not so bad!'" He turned to Franklin. "How about it, Franklin? You want to go home? You want to see your dogs?"

Franklin's face changed to a huge, toothless grin. The grizzled hair surrounding his face made him look a little kingly. "That's fine," he whispered.

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