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Comparative Salary-Related Costs of a Brief App-directed Delirium Identification Protocol by Hospitalists, Nurses, and Nursing Assistants

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Abstract

Background: Systematic screening can improve delirium identification among hospitalized older adults. Prior studies have shown clinicians and health system leaders may believe they do not have the time and resources for assessment. We conducted a comparative salary-related cost analysis of an adaptive delirium identification protocol directed by an iPad app.

Methods: We recruited 527 older adult medicine patients from an urban academic medical center (n = 269) and a rural community hospital (n = 258). Physicians and nurses completed the two-step Ultra-brief Confusion Assessment Method (UB-CAM) protocol (with or without a skip pattern), while certified nursing assistants completed only the UB-2 ultra-brief screen. The sample included 527 patients (average age 80, 57% women, 35% with dementia). Time required to administer

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the protocol was collected automatically by the iPad app. Salary-related costs of screening were determined by multiplying the time required by the hourly wage for the three disciplines, as obtained from national and regional published healthcare salary cost data. Cost estimates for entire hospital implementation were also calculated.

Results: Participants were screened on 924 hospital days by 399 clinicians (53 physicians, 236 nurses, 110 CNAs). For the UB-2, CNAs cost per screen was lower than the other clinician types ($.37 per screen vs. $.73 for nurses and $2.39 for hospitalists). For the UB-CAM with skip (UB-CAM), costs per protocol were $1.10 for nurses vs. $3.61 for physicians. The annual salary-related costs of hospital-wide implementation of a nurse-based UB-CAM protocol in a medium sized (300-bed) hospital was $63,015 plus $4,356 for initial and annual training.

Conclusions: CNAs and Nurses had the lowest salary-associated costs for app-directed CAM-based delirium screening and identification, respectively. Salary-related annual hospital costs for the most efficient protocols in a medium-sized hospital were less than the annual cost of hiring 1 FTE of the discipline performing the protocols.

Keywords

Delirium; screening; cost-analysis; implementation

INTRODUCTION:

Delirium is associated with poor health outcomes, including increased mortality, a decline in physical and cognitive functioning, falls, nursing home placement and death.[1–3] Total U.S. direct 1-year healthcare costs attributable to delirium are $143 to $152 billion overall, and $26 to 42 billion for older surgical patients, comparable to heart failure and diabetes.[4,5]

Despite its outcomes and costs, less than half of all delirium cases are detected in routine care.[6] Delirium that is undetected leads to increased suffering for the older adult and their care partners, increased staff burden and stress, and a missed opportunity to intervene.[7–10] Delirium that is hypoactive (without behavioral disturbances), superimposed on dementia, and in those over age 80 is most likely to be missed.[11]

Prior studies have shown health professionals may believe they do not have the time and resources, lack confidence in delirium assessment, think little can be done, and greatly under appreciate the harms from delirium.[12, 13] Many hospitals do not appreciate that delirium is often a medical emergency. Although prior studies have examined the cost of dementia screening,[14] no published studies have examined the salary-related costs associated with delirium screening.

Our team developed and field tested the Ultra-brief CAM (UB-CAM) [15,16–18], a two-step delirium identification protocol that includes an ultra-brief 2-item screen (UB-2) paired with a validated diagnostic tool (3D-CAM). If hospitalized older adults answer both UB-2 questions correctly, the protocol ends and delirium is not present; otherwise, the 3D-CAM is administered. We built an application (app) and used an iPad to deliver and test the UB-CAM, and previously reported that physician hospitalists, registered nurses, and Certified Nursing Assistants (CNAs) can administer the protocol effectively, with overall accuracy

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in the high 80%'s [19]. The current study compares the salary-related cost of implementing the UB-CAM with and without the skip pattern at the bedside, as administered by the three types of clinicians noted above (see Supplemental material). Secondly, we estimate the salary-related costs of implementing systematic delirium identification among all older patients in hospitals of various sizes.

METHODS:

This cost analysis is part of the READI, Researching Efficient Approaches to Delirium Identification, study, which recruited older adult medicine patients from an urban academic medical center and a rural community hospital. This study was approved by the Institutional Review Board (IRB) of both study sites.

Physician hospitalists and registered nurses delivered the two-step UB-CAM protocol, while CNAs delivered only the UB-2, since this was considered a "vital sign" and within their scope of practice[20]. The second step of the UB-CAM was administered two ways. The first, the UB-CAM without skip, was by completing all remaining 18 items of the 3D-CAM. The second, the UB-CAM, employed a skip pattern, where the first "positive" item (incorrect answer on a cognitive test, positive patient symptom report, or positive interviewer observation), both triggered the corresponding CAM feature and resulted in skipping the remaining 3D-CAM items in this feature.

Per Protocol Cost Methods

Because this was a new protocol with no previous data describing its cost, activity-based costing methods were used.[20, 21] This involved measuring the time required to carry out the protocol and multiplying this time by the hourly cost (including 30% fringe) of the discipline administering the protocol, averaged across the two clinical sites. All clinicians completed their assessments using an iPad app that automatically timed their assessments. Average completion times were computed for the UB-2 alone (for all 3 disciplines), and UB-CAM and UB-CAM without skip (physicians and nurses only). Assessment times, along with average salary data for hospitalists, nurses and CNAs obtained from regional and national data, were used to calculate the cost.

We also computed a simulated cost of a hypothetical protocol in which a CNA administered the first step of the UB-CAM and a nurse followed with the second step when needed. Prior to protocol implementation, all clinicians underwent brief training on the protocols—15-20 minutes for CNAs, and 30 minutes for physicians and nurses. The salary costs related to training were not included in the average per protocol or total screening costs.

Institutional Cost Methods:

Next, we computed estimated salary-based costs of implementing the UB-CAM in hospitals with 100, 300 and 600 beds, assuming that 50% of patients in hospitals are over 65[22] and that all patients aged 65 or over would be screened daily for delirium. For these estimates, we used national average salaries in 2020 for CNAs ($32,050) and nurses ($80,010) obtained from the Bureau of Labor Statistics National Occupational Employment and Wage Estimate database[23] and the average salaries of hospitalists ($267,000) obtained from the

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2020 Medscape Hospitalist Compensation Report.[24] A fringe rate of 30% was added to the salaries.

Training Cost Methods:

To calculate staff training costs for a 100-, 300-, and 600-bed hospital, we used the actual training time from our study, 15 minutes for CNAs and 30 minutes for nurses and hospitalists, multiplied by the hourly rate for each discipline. To estimate the numbers of clinicians who would have to be trained, we conservatively estimated that we would have to cover every bed in the hospital (since clinicians generally care for a mix of younger and older patients), and used the staff to bed ratio of 5:1 for nurses, 10:1 for CNAs, and 15:1 for hospitals based on reported averages.[25] We also said that since nurses and CNAs generally work 3 shifts/week[26], and hospitalists work every other week, we estimated that would take 3 nurses and CNAs, and 2 hospitalists, to cover each bed during the day shift, when screening would be performed. Finally, we assumed that all staff would be trained initially and annually.

All analyses were completed in SAS™ software, Version 9.4, and Microsoft Excel version 2016.

RESULTS

Study Participants:

Three-hundred ninety-nine clinicians, including 53 physician hospitalists, 236 nurses, and 110 CNAs, participated, and were briefly trained in the UB-CAM prior to participating in the study. Of the nurses, 100% were registered nurses (6% had an Associate Degree, 86% Bachelors, and 7% Masters). Over half of all clinicians (73%) were in practice for five years or less. Almost all clinicians reported previous experiences with delirium. Only five of the 399 reported being certified in geriatrics or gerontology (one physician, 2 nurses, and 2 CNAs).

Additionally, 527 hospitalized older adults were enrolled in our study 269 at the academic center, and 258 at the community hospital. The mean age was 80 years old, 43% were male, and 85% were white, non-Hispanic. Dementia was present in 183 (35%). Patients were assessed by a reference standard rater for up to 2 hospital days, and delirium was present in 153/924 assessments (17%) and in 114/527 patients (22%). Further details of the reference standard assessments have been previously reported.[27]

Comparative Costs per Delirium Identification Protocol:

We previously reported the feasibility, speed, and accuracy of the protocol.[27] Mean times required and costs per screen by clinician type are reported in Table 1 For the UB-2 alone, the average cost per screen was lowest for CNAs ($0.37) compared to nurses ($0.73) and hospitalists ($2.39). As expected, the average per screen cost of administering the UB-CAM ($1.10 for nurses, $3.61 for physicians) were lower than for the UB-CAM-without skip ($1.66 for nurses, $5.59 for physicians). The cost of the simulated CNA-nurse UB-CAM (CNA first step, nurse second step when needed) was slightly lower than the nurse UB-CAM

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($0.78 versus $1.10). Costs were similar when national average salaries were used (Figure 1).

Simulated annual implementation costs by hospital:

Projected annual salary-based costs of implementing delirium screening in hospitals of various sizes are presented in Table 2, using 2020 national average salaries for CNAs, nurses, and hospitalists. Implementing the CNA-conducted UB-2 only ultra-brief screen in a 300-bed hospital would cost $18,895 per year. The lowest cost option for implementing the UB-CAM would be the simulated CNA/Nurse protocol, which would cost $42,339 in a 300-bed hospital. The nurse conducted UB-CAM was slightly more expensive at $63,016, and the hospitalist-conducted UB-CAM was much more expensive at $209,407 in a 300-bed hospital. Costs in a 600-bed hospital would be double that of a 300-bed hospital.

Simulated initial and annual training costs

Lastly, we computed the costs of training for delirium screening. Even with the conservative assumptions described in the Methods, the annual training costs were small relative to implementation costs, totaling $485 for CNA-based screening, $4,356 for nurse-based screening and $3,113 for hospitalist-based screening in a 300-bed hospital. Training costs for a 600-bed hospital would be double these, and for a 100-bed hospital would be 1/3 of these.

DISCUSSION:

Using prospective app-collected data on clinician administration time and corresponding clinician wage information, we found that the salary-related costs for delirium identification are relatively inexpensive. The lowest costs per screen were the CNA nurse UB-CAM at 78 cents per screen and nurse UB-CAM at $1.10 per screen. Similarly, the annual salary-based costs of implementing hospital-wide screening are reasonable, less than the salary costs of 1 FTE of the discipline doing the screening in a 300-bed hospital. For instance, the cost of implementing nursing screening would be $63K, less than the cost of hiring of a nurse in most regions of the country.

To our knowledge, this is the first study to examine and compare the salary-based costs of bedside delirium screening among different sets of clinical staff. One important innovation tested in this study was utilizing nursing assistants in the initial delirium screen. CNAs are trained in assessing vital signs, communicating these to the nurse; thus, completing and reporting delirium vital signs is within the scope of practice for CNAs.[17,18,28] We previously reported that for the UB-2, CNAs had equal sensitivity to nurses and physicians, while for the two-step protocol, nurses had equal sensitivity, specificity, and overall accuracy to physicians. These data suggest that all team members have value in delirium screening and had high accuracy with our tools. Using our data, facilities could decide which approach worked best with their setting and workflow. If considering the costs of the screening is important, the value of care may be improved by CNA and nurse-directed delirium identification programs compared to physician-driven programs.

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The overall annual screening costs for medium-sized hospitals ($63K for the nurse 2-step protocol) is less than the one-year cost of delirium complications and care for even one older adult, previously estimated at $64,421. Moreover, evidence suggests that early recognition may reduce costs. A retrospective analysis of 82 hyperactive delirium patients found those with delirium detected during hospitalization had a significantly fewer delirium episodes (n = 1.75) than patients whose delirium was detected after hospitalization (n = 2.31). Patients whose delirium was detected early vs, late also had significantly shorter length of stay (6.85 versus 13.61 days, p = 0.002).[29] Hence, screening, early detection, and evidence-based best practices for management could yield a significant return on investment and improvements in care. Understanding screening costs supports our previous work showing the feasibility, accuracy, and efficiency of the UB-CAM and describing barriers and facilitators of screening for delirium.[16, 17]

The Institute for Healthcare Improvement (IHI) has enrolled over 2000 health systems in their Age-Friendly Health System initiative.[30] The current study provides valuable cost and accuracy information for healthcare leaders and front-line clinicians implementing bedside delirium screening, an important part of the “Mentation” component of age-friendly care. During the COVID-19 pandemic, delirium has been a frequent complicating factor of hospitalizations (affecting 28% of older adults) and is a presenting symptom of COVID-19; therefore, this information is especially relevant in the current era.[31]

Some limitations deserve comment. First, we considered only salary-based costs of delirium identification. We did not consider the costs of workups that could be triggered by delirium identification, nor cost-savings that might occur from early recognition and timely evaluation and management of delirium. Nor did we consider increased revenues from better documentation. Second, although we include both a large urban hospital and a small regional hospital, the extent to which our cost estimates can be generalized to other facilities may be limited. The salaries are based on national data, but actual salaries may vary greatly based on location, years of experience, and other factors. A third limitation is that the CNA-nurse UB-CAM protocol was not explicitly implemented in our study. Instead, the cost was simulated using average times for CNAs doing the UB-2 and nurses doing the 3D-CAM. This simulation does not consider the time for communicating the results and connecting the staff that combine to do the two-step process. This will be part of our future work. Finally, the patients in our study were not meant to be representative, but rather a purposefully challenged sample enriched for older age and dementia. Since patients with delirium and dementia take longer to assess,[16] the costs reported may represent an overestimate of hospital-wide implementation, which would include younger, less impaired patients.

In conclusion, this study presents estimates of per assessment and annual hospital salary-based costs of implementing the UB-CAM 2-step delirium identification protocol, by physicians, nurses, and CNAs, thereby advancing the implementation and sustainability science of delirium screening. Costs of such implementation pale in comparison to the complications and costs of delirium. Future studies should consider additional costs beyond staff salaries and evaluate whether patient outcomes and health system costs can be improved with early identification and treatment of delirium.

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Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Points

1. This is the first published study to examine and compare the salary-based costs of bedside delirium screening among different sets of clinical staff and to involve nursing assistants in delirium screening.
2. We report that delirium screening can be fast, accurate, and relatively inexpensive, at 78 cents per screen using a nursing assistant and nurse.
3. These data suggest that all team members have value in delirium screening and had high accuracy with our tools. Using our data, facilities could decide which approach would work best with their setting and workflow

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Why Does This Paper Matter?

Delirium is common, morbid, and costly in older adults. Delirium that is undetected leads to increased suffering for the older adult and their care partners, increased staff burden and stress, and a missed opportunity to intervene. This study provides valuable comparative cost information for healthcare leaders and front-line clinicians implementing bedside delirium screening and has the potential to transform care by demonstrating that delirium screening can be quick, accurate and inexpensive.

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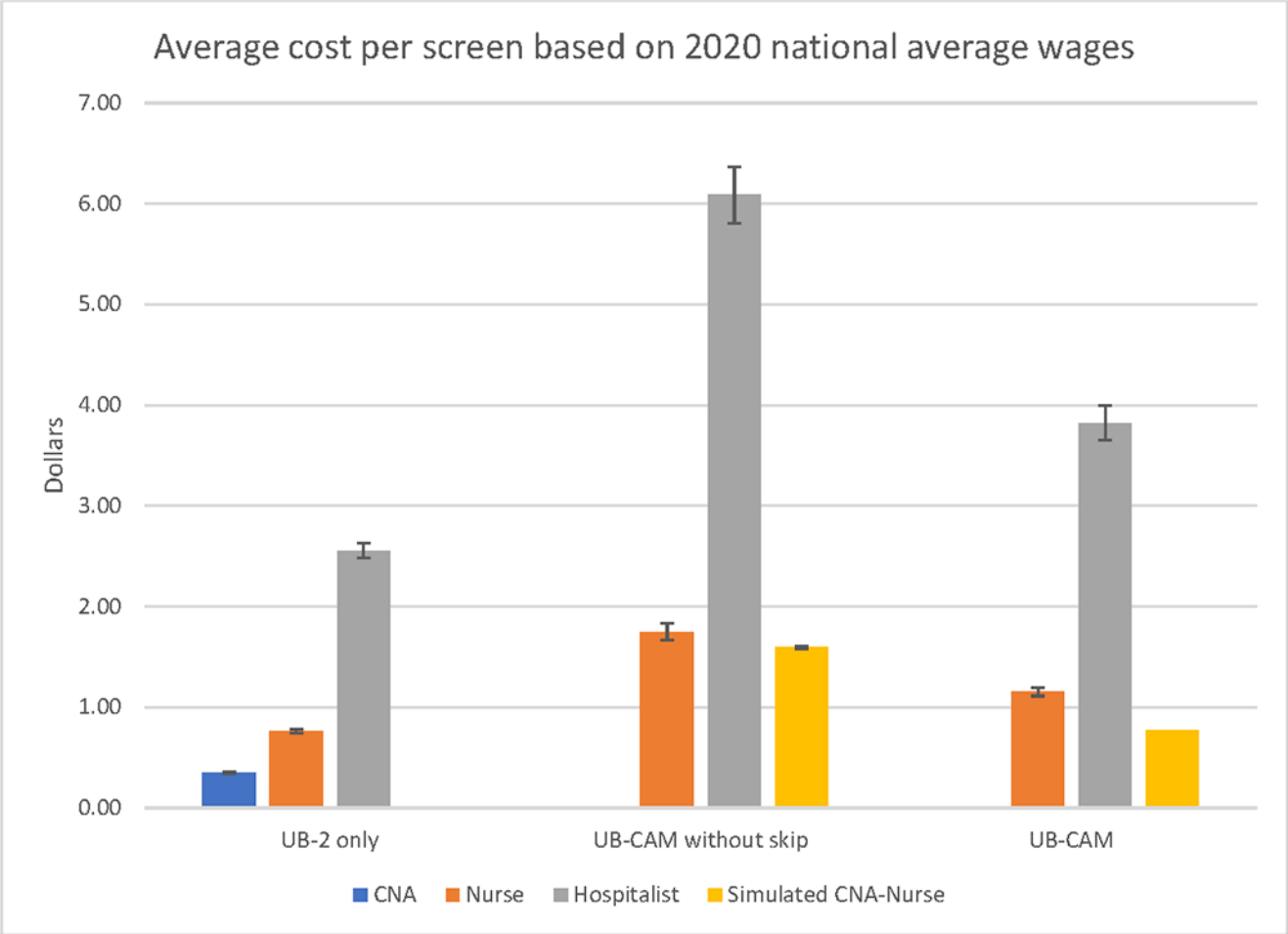

Figure 1. Average cost per screen based on 2020 national average wages.

2020 U.S. national average salaries for certified nursing assistants (CNAs, $32,050) and nurses ($80,010) obtained from the U.S. Bureau of Labor Statistics. Average annual salaries for hospitalists ($267,000) obtained from the 2020 Medscape Hospitalist Compensation Report. Projected annual screening costs include a 30% fringe rate (U.S. Bureau of Labor Statistics). Costs per screen are presented for the two-item ultra-brief screener (UB2), the UB-CAM-without skip (UB-2, followed when needed by the 3D-CAM without using a skip pattern, and UB-CAM (the UB-2, followed when needed by the 3D-CAM with the skip pattern). Error bars represent standard errors of the means.

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Table 1.

Average times and costs per screen at the study sites

					UB-CAM	
	UB-2 only		**UB-CAM without skip**		**UB-CAM**	
Personnel	**Time (sec)**	**cost per screen ($)**	**Time (sec)**	**cost per screen ($)**	**Time (sec)**	**cost per screen ($)**
CNA	62.0 ± 51.3	0.37 ± 0.30	N/A	N/A	N/A	N/A
Nurse	54.8 ± 33.0	0.73 ± 0.43	125.9 ± 123.9	1.66 ± 1.64	82.9 ± 61.0	1.10 ± 0.83
Hospitalist	55.1 ± 43.9	2.39 ± 2.19	131.3 ± 124.4	5.59 ± 5.58	82.5 ± 76.1	3.61 ± 3.67
Simulated CNA-Nurse	N/A	N/A	151.9 ± 50.7	1.57 ± 0.77	92.8 ± 42.4	0.78 ± 0.53

UB-2 = 2-item ultra-brief screen; UB-CAM: Ultra-brief CAM, which consists of the UB-2 ultra-brief screen, followed in positive screens by all of the remaining items in the 3D-CAM (UB-CAM without skip) or the 3D-CAM with a skip pattern (UB-CAM). CNA=Certified Nursing Assistant. Costs are reported in 2020 dollars. Cost per screen based on average annual salaries at the study sites of $34,466 for CNAs, $77,438 for Nurses and $249,023 for Hospitalists (not including fringe). Average costs per screen include a 30% fringe rate.

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Table 2.

Projected annual screening costs by hospital size, rounded to nearest $1000 (Mean ± SD)

	HOSPITAL SIZE		
SCREENING MODALITY	**100 BEDS**	**300 BEDS**	**600 BEDS**
UB-2 ONLY			
CNA	$6,000 ± 5000	$19,000 ± 16000	$38,000 ± 31000
Nurse	$14,000 ± 8000	$42,000 ± 25000	$83,000 ± 50000
Hospitalist	$47,000 ± 37000	$140,000 ± 111000	$280,000 ± 223000
UB-CAM			
UB-CAM without skip			
Nurse	$32,000 ± 31000	$96,000 ± 94000	$192,000 ± 188000
Hospitalist	$111,000 ± 10500	$333,000 ± 316000	$666,000 ± 631000
Simulated CNA/Nurse	$29,000 ± 14000	$87,000 ± 42000	$174,000 ± 84000
UB-CAM			
Nurse	$21,000 ± 15000	$63,000 ± 46000	$126,000 ± 93000
Hospitalist	$70,000 ± 64000	$209,000 ± 193000	$419,000 ± 386000
Simulated CNA/Nurse	$14,000 ± 10000	$42,000 ± 29000	$85,000 ± 58000

Assumes that 50% of patients in hospitals are over 65 and that they would be screened daily. 2020 U.S. national average salaries for certified nursing assistants (CNAs, $32,050) and nurses ($80,010) obtained from the U.S. Bureau of Labor Statistics. Average annual salaries for hospitalists ($267,000) obtained from the 2020 Medscape Hospitalist Compensation Report. Projected annual screening costs include a 30% fringe rate (U.S. Bureau of Labor Statistics).