

Perspectives of Nursing Homes Staff on the Nature of Residents-Initiated Call Lights

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Abstract

Little research has been conducted to capture the perceptions of nursing home staff when using the call light system. There is also a lack of information regarding the effects that these perceptions of the call light system have on their workload, safety, quality of care, or overall satisfaction. In response to the high volume of complaints from residents and their families regarding long response times to call light alarms, we developed this exploratory cross-sectional survey study. This study aims to capture nursing home staff experiences while using a call light system; to investigate the challenges the staff face when using the system; and to determine how these challenges contribute to their workload, performance, and satisfaction. A survey instrument was developed and distributed to all 153 of the nursing staff, certified nursing assistants, and licensed practical nurses in a nursing home in upstate New York. A total of 105 completed surveys were retrieved for an overall response rate of 68.63%. Descriptive analysis, Pearson correlation, and the Kruskal–Wallis test were used to analyze the collected data. The results showed a significant correlation between the processes of being notified and locating call light alarms and workload. The staff reported many usability challenges that may contribute to longer response time such as lack of prioritization, low/no discriminability, noise, and overwrite previous alarm. In addition, 78% of the staff agreed that responding to a call light can prevent serious harm; however, 56% of the staff agreed that call light system is not meaningful; and around 78% think that call light system is disruptive in the environment and source for constant noise. The study finds that incorporating the insights provided by nursing home staff may improve the acceptance of new and existing technology, which ultimately improves the delivery of care through greater usability.

Keywords

nursing home, staff perspectives, feedback, employee voice, call light technology, healthcare outcomes

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Introduction

The patient call light system is an essential mode of communication in the delivery of health-care services in nursing homes. Call light systems, defined as a bedside button, are typically tethered to the wall in a patient's room directing signals to the nursing station to indicate when patients have perceived a need requiring the attention of the nurses on duty (Tzeng & Larson, 2011). For nursing homes, the call light system is a lifeline linking nursing home residents to immediate assistance (Tzeng & Yin, 2010). Studies have found that the call light system may have direct and indirect effects on patient satisfaction, adverse events such as falling, and other general health outcomes. Therefore, a better understanding of the interactions with the call light system can help

to improve patient safety and increase the quality of care (Meade, Bursell, & Ketelsen, 2006). However, despite their prevalence in nursing homes and their importance to patients' experience and safety outcomes, the influence of the call light system as a communication tool has been largely ignored in the literature. Furthermore, despite the importance of call light systems in ensuring patient safety, quality of care, and general health

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outcomes, surprisingly little research has been done on how call light systems are being used (Ali & Li, 2019; Kalisch, Labelle, & Boqin, 2013; Tzeng & Larson, 2011).

Call light technology has continued to develop over the years to significantly increase its functionality. The goal of these newer call light systems is to provide more than a means for beckoning nursing personnel to the residents' rooms (Kalisch et al., 2013; Yang & Rivera, 2015). One example of a company that has greatly impacted call light technology is Vocera. Their nurse call integration allows patients to communicate directly with their assigned nurse and allows for the nurse to call the patient back and the patients will get the message through a pillow speaker (Yang & Rivera, 2015). Although these advances provide improvements for workflow and offer an opportunity to improve response times, none of these systems have improved efficiency, increased patient safety, or reduced cost (Ali & Li, 2019; Tzeng, 2010).

Nursing home residents often have complex mental and physical conditions with varying levels of patient acuity and dependency. More than 50% of nursing homes' residents have some form of dementia or cognitive impairment, including Alzheimer's. These residents are often functionally dependent, exhibiting memory loss, urinary incontinence, and limited verbal ability (Toot, Swinson, Devine, Challis, & Orrell, 2017). Nursing staff would, therefore, present a unique experience of servicing residents who are likely unable to use the call light appropriately. Studies find that residents largely assume that the nurse will respond immediately to the call light (Deitrick, Bokovoy, Stern, & Panik, 2006; Tzeng, 2010). Nursing staffs, however, may perceive the call light as a nuisance, associating the alarm as a noise and interruption to their tasks, instead of as an important way for patients to request assistance (Deitrick et al., 2006; Meade et al., 2006; Roszell, Jones, & Lynn, 2009). The perception of the call light systems as a distraction rather than an essential tool by nursing home staff poses a potential threat to patient safety, as it may encourage nurses to neglect patient calls for assistance or delay in responding to patients. This may hinder nurse-patient communication, as well as trust in the quality of care, which are essential inpatient satisfaction outcomes (Deitrick et al., 2006; Tzeng, 2011a).

The literature suggests that the negative perceptions of call lights felt by nursing home staff are likely caused by challenges in usability, and these challenges are caused by a lack of user feedback (Ali & Li, 2019). A study, which tested the reactions of nurses to new technology, suggests that nurses respond positively to opportunities to provide feedback on the technology they use (Kent et al., 2015). The study ultimately found that including the nursing staff in the early design phase of

new technology allows them to influence the overall design, which results in higher satisfaction and overall acceptance (Kent et al., 2015). The input from nurses is commonly excluded from the narrative of how technology impacts health-care professionals and health care in general. There are many studies showing the impact of technology on patients, but few that show a nurse's perspective (Deitrick et al., 2006; Tzeng, 2011a). Research suggests that only assessing residents' satisfaction with the call light system limits the way developers understand the usability of their technology (Ali & Li, 2019, 2020; Ali, Li, & Wong, 2017). As a result, ideas and solutions addressing the delays in call light responses have involved improving usability from a patient-centered and largely administrative perspective. This results in innovations in the technology or process that allow residents to alert nurses faster by creating louder and more varied alarms. This limited scope of perspectives also explains why usability concerns, such as noise and the lack of features that organize multiple call notifications, have gone largely ignored despite the efforts made to improve the call lights residents-centered features (Deitrick et al., 2006; Meade et al., 2006; Roszell et al., 2009; Tzeng, 2011a).

Nursing staff acceptance of the implementation of technological improvements is crucial. Furthermore, failure to gain the acceptance of end users can cause higher work-related stress and negative perceptions of the technology. As a result, this can ultimately lead to nurses ignoring, in part or completely, certain features of the technology due to gaps in its usability (Deitrick et al., 2006; Meade et al., 2006; Roszell et al., 2009). Studies show that for the call light system to be fully accepted by nursing staff, they must believe that technology enhances their job. They do not want to have to work with technology that requires additional effort to use (Tubaishat, 2018). The perception of new technology can influence the balance between utility and usability expected by the nursing staff. Studies find that technology with greater utility is perceived as having greater benefits and rewards (Meyer & Schwager, 2007; Tubaishat, 2018). Following this study, the staff is more willing to cope with the difficulties of technology usage if they perceive the benefits outweigh the efforts of using it. Feedback from the nursing staff is required to determine the level of design that fits not only the function of the technology but also the user's expectations of the technology (Lorenzi, Kouroubali, Detmer, & Bloomrosen, 2009; Shove, 2003). By applying the acceptance model to the nursing home setting, the study finds that failure by the improved call light system to meet nursing staff expectations may cause lower motivation for nursing staff to engage with the technology. Furthermore, negative opinions are often associated with improved technology (Kripalani, Theobald, Anctil, & Vasilevskis, 2014).

These negative opinions manifest into negative attitudes and perceptions about the call light (Meade et al., 2006; Tzeng, 2010), which in turn shapes behaviors that act as barriers in the delivery of health-care services (Deitrick et al., 2006; Roszell et al., 2009), and contribute to poor performance in the use of an improved call light system (Tzeng & Yin, 2008, 2009).

The literature finds that continuing to ignore nurses' feedback in the development of new technology will only widen the gap between nursing staff and patients (Deitrick et al., 2006; Kent et al., 2015; Tzeng, 2011a). This gap is associated with adverse effects on the safety of the patient (Deitrick et al., 2006; Tzeng & Yin, 2008, 2009). Overall, nursing home staff perceptions and responsiveness to call lights are not well understood, as little research has been done to investigate user experiences with the call light system. Nursing homes report seeing longer response times despite the improvements made to call light systems (Ali & Li, 2019; Kalisch et al., 2013; Lasiter, 2014; Meade et al., 2006). These long response times might be associated with usability issues and challenges the staff faces with the current call light systems (Ali & Li, 2019, 2020; Kripalani et al., 2014; Tzeng & Yin, 2009).

Aim

The aim of this study was to investigate how nursing home staff members perceive the nature of call lights and understand their perceptions when interacting with the system in order to determine what factors contribute to the delays in responding to call lights. The study was conducted in a nursing home in upstate New York (NY) that is planning to acquire a new call light system in order to overcome a high volume of complaints from residents and their families regarding long response times to call light alarms. The nursing home's administration was looking to implement a system that tracks the caregiver's response time to call lights and hold them accountable. This study was an attempt to understand the perspective of certified nursing assistants (CNAs) and licensed practical nurses (LPNs) and their experiences using the call light system in their daily work.

Methods

A cross-sectional survey instrument was developed and validated in three phases:

1. Survey design: An initial draft of the survey was developed based on the literature and expert review of content and design.
2. Pilot testing: The initial draft was distributed to a small sample of nursing home staff to test reliability and validity.

3. The survey instrument was distributed to all the nursing home's staff (CNAs and LPNs) working in the nursing home, and the data were collected and analyzed.

Setting and Participants

The study was conducted in a 300-bed, public nursing home in upstate NY that has long-term care unit and short-term care unit as well as restorative nursing care. In addition, the nursing home provides physical, occupational, and speech therapy. The nursing home has private and semiprivate rooms that are connected to a call light system consisting of a display panel located in the nurse's station. Indications of an alarm can only be viewed from this screen and the corresponding light above the resident's door, which flashes during an alarm. All the staff, 153 CNAs and LPNs working in this setting, were invited to participate after obtaining oral consent. The study was approved by both the university and the nursing home's institutional review boards.

Instrument Development

A survey instrument was designed based on expert opinions and studies created with similar research goals (Ali & Li, 2019, 2020; Ali et al., 2017; Deitrick et al., 2006; Li & Ali, 2015; Meade et al., 2006; Tzeng, 2011a; Van Handel & Krug, 1994). These insights were used to draft a preliminary list of items that were important to measure, such as perceived mental and physical workload, noise, the process of responding and location call lights, unit layout effect, perceived nature of call lights, and overall satisfaction with the call light system. The preliminary list of items was distributed and discussed with two nursing homes administrators, two faculty members in the nursing school with more than 15 years of experience working in nursing home setting, one survey instrument design expert, one system engineer with 10 years of experience in health-care outcomes research, two nursing homes unit managers, two LPNs, and three CNAs. The experts checked the adequacy of the content to represent the objectives of the study and the items' appropriateness and word use. As a result of the experts' comments, one item was removed and the use of words in the survey was modified for increased clarity.

Table 1 shows the items used to measure the studied concepts included demographic (Item 6), perceived workload (Items 7–13), noise (Item 14), ease of being notified of call lights (Item 15), ease of locating call lights (Items 16–17), the nature of call light use (Items 18–20), overall satisfaction of the way the call light system works (Item 21), and three open-ended questions to obtain any other concerns the staff has.

Table 1. Items included in the Survey Instrument.

Demographic characteristics		Scale	
1. Gender (1 = male, 0 = female)		2. Age (1 = 16–21, 2 = 22–27, 3 = 28–33, 4 = 34–39, 5 = 40–45, 6 = 46–51)	
3. Job title (1 = CNA, 2 = LPN)		4. Unit (1 = short term, 2 = long term, 3 = dementia)	
5. Shift (1 = morning, 2 = evening, 3 = night)		6. Years of Experience	
Call light-related domains		Scale	
Workload		Strongly disagree	Strongly agree
7. The way you are being notified about call lights requires concentration/attention	Do not know	Somewhat disagree	Somewhat agree
8. Call lights are interruptions that interfere with your planned tasks (prevents you from doing the critical aspects of your role)	Do not know	Somewhat disagree	Somewhat agree
9. You feel stress due to the high rate of call lights.	Do not know	Somewhat disagree	Somewhat agree
10. In case you have more than one call light at the same time, you need to concentrate when locating the call lights	Do not know	Somewhat disagree	Somewhat agree
11. In case you have more than one call light at the same time, you need to think as to which bell you answer first	Do not know	Somewhat disagree	Somewhat agree
12. You divide your attention between multiple tasks while responding to a call light	Do not know	Somewhat disagree	Somewhat agree
13. It is hard to prioritize when having more than one alarm at the same time	Do not know	Somewhat disagree	Somewhat agree
14. The call light system is a source of noise	Do not know	Somewhat disagree	Somewhat agree
15. It is hard to be notified about the different alarms in the unit	Do not know	Somewhat disagree	Somewhat agree
16. It is hard to locate a call light due to the unit layout	Do not know	Somewhat disagree	Somewhat agree
17. In general, is it hard to locate call lights	Do not know	Somewhat disagree	Somewhat agree
18. To what extent do you believe call lights are important for residents' safety?	Not at all	To some extent	To a moderate extent
19. To what extent you believe the reasons for call lights are meaningful?	Not at all	To some extent	To a great extent
20. To what extent do you believe responding to a call light can prevent serious harm?	Not at all	To some extent	To a great extent
21. To what extent are you satisfied with the way the call light system works?	Not at all	To some extent	To a great extent
Open-ended questions			
22. What are your thoughts, concerns, and ideas regarding the current call light system?			
23. If the newly implemented system has the ability to track your response time, how will that make you feel? AND, do you think this will affect (reduce/ improve) your response time?			
24. Do you think it will change your behavior? How?			
25. Do you think it will change the staff behavior? How? (e.g., will anyone will tend to cancel the call light without assisting the resident?)			

Note. CNA = certified nursing assistant; LPN = licensed practical nurse.

Pilot Study

A pilot study for the survey instrument was carried out, employing qualitative and quantitative approaches to check the external reliability (test–retest) and internal reliability (Cronbach α ; Campbell, 1991; Polit & Beck, 2010; Reeves & Capra, 2003). Ten nursing home staffs from different units and different shifts were invited to participate in the pilot study. Participants were asked to complete the final draft of the survey as well as to take part in short interviews immediately after. During the short interviews, participants were asked about the clarity and wording of the survey items, the relevance of the content, and the time it took to finish the survey. The second session took place 2 weeks later and consisted of participants answering only the closed items from the survey to check test–retest reliability (Oroviogicochea, Watson, Beortegui, & Ramirez, 2010).

The participants agreed that the survey was not long and that the items were relevant to the constructs, choosing not to exclude any item. Cronbach's α was within the acceptable range ($\alpha > .7$), except for the nature of the call lights domain, and this might be explained by the low number of items in that domain (Bryman & Cramer, 2005; Gerrish & Lacey, 2013; Taber, 2018). The intra-class correlation coefficient (ICC) was used to assess the strength of agreement between Time 1 and Time 2 of test–retest reliability. The single fixed raters ICC was selected to measure the response variations that come from different respondents' agreement over a short period (Yen & Lo, 2002), and the results were within the acceptable range, $>.07$ (Kanste, Miettunen, & Kyngas, 2007) except the overall satisfaction and ease of being notified about the call light alarms as their ICC was found $<.7$. Therefore, the test–retest reliability of the measures was considered adequate and no modifications were required for the survey. To confirm there are no significant differences between the mean scores for each item in Time 1 and Time 2, paired-sample t test was conducted, and all the results were not significant ($p > .05$).

Analysis

A cross-sectional survey was conducted in a nursing home situated in upstate NY. A paper version of the survey was administered at the beginning of the shifts among nursing staff ($n = 153$). The nursing staff was instructed to return the survey in a box at the front desk that was previously prepared. After 10 days, 105 surveys were collected (68.63%) which was considered adequate for the current analysis. The Kruskal–Wallis test (Cordon & Foreman, 2009; Kruskal & Wallis, 1952) was conducted to determine whether there were

significant relationships between the demographic factors and the domains such as workload, noise, ease of being notified, ease of locating the call light alarms, nature of call lights, and overall satisfaction about the use of call light technology. These demographic factors (gender, job title, age, unit, shift, and years of experience) were tested to determine whether they had any effect on the main domains. Following this test, a post hoc test was conducted to determine the significant differences (if any) in the levels of demographic factors. Pearson correlation analysis was conducted to measure the strength and direction of relationships between the domains. Qualitative techniques of coding were used to analyze the open-ended questions to determine common themes among the responses from the participants.

Results

Descriptive statistics were calculated to summarize the state of the nursing home's staff. The demographic data were collected and documented in Table 2. Of the respondents, 75.25% were CNAs ($n = 79$), and 90.5% were females ($n = 95$). Around 67.5% ($n = 71$) were less than 39 years old and 32.5% ($n = 34$) were more than 40 years old. The range of years of experience was 31 (minimum = 1, maximum = 32), and 66% of respondents had more than 5 years' work experience ($n = 70$), 44.8% ($n = 47$) were working on the morning shift, and 46.7% ($n = 49$) were providing care in long-term units as shown in Table 2.

Table 3 shows the response rates of participants based on demographic characteristics. This, in conjunction with our tests found in Table 4, was used to determine the perspectives of nursing home staff in the use of the call light as well as the nuance of their perspectives along with different levels of our demographic variables.

Table 4 shows the Kruskal–Wallis test results. The goal of this test is to assess the differences in the survey responses of staff, along with our independent demographic variables. Gender was found to have a significant effect on responses to noise ($p < .001$), location ($p < .01$), and satisfaction ($p < .05$). Age was also found to have a significant effect on responses to noise ($p < .01$), ease of being notified ($p < .001$), and overall satisfaction ($p < .05$). The job title was found to have a significant effect on responses to overall satisfaction ($p < .01$). The unit was found to have a significant effect on responses to workload ($p < .05$) and noise ($p < .001$). Shift has a significant effect on the responses to noise ($p < .001$), ease of locating ($p < .001$), overall satisfaction ($p < .01$), and the perception of the call light ($p < .05$). Years of experience were found to have a significant effect on responses to notification ($p < .05$) and overall satisfaction ($p < .001$).

Table 2. Descriptive Statistics.

Variable	N	Frequency, n (%)
Gender	105	
Female		95 (90.5)
Male		10 (9.5)
Age	105	
16–21		4 (3.8)
22–27		16 (15.2)
28–33		33 (31.4)
34–39		18 (17.1)
40–45		17 (16.2)
46–51		9 (8.6)
>51		8 (7.6)
Job title	105	
CNA		79 (75.2)
LPN		26 (24.8)
Unit	105	
Short term		20 (19.1)
Long term		49 (46.7)
Dementia		36 (34.3)
Shift	105	
Morning		47 (44.8)
Evening		30 (28.6)
Night		28 (26.7)
Year of experience	105	
≤10		59 (56.19)
11–20		29 (27.62)
>20		17 (16.19)

Note. CNA = certified nursing assistant; LPN = licensed practical nurse.

Table 4 also shows the Dunn test for post hoc results. The goal of the test is to test for statistically significant differences in the survey responses of staff within our independent demographic levels. Female nursing home staffs were found to score higher on ease of location ($M_{\text{Male}} = 3.45$; $M_{\text{Female}} = 3.64$, $p < .05$). Male nursing home staffs were found to score higher on noise ($M_{\text{Male}} = 4.60$; $M_{\text{Female}} = 3.53$, $p < .05$) and overall satisfaction ($M_{\text{Male}} = 2.10$; $M_{\text{Female}} = 2.49$, $p < .05$). Nursing home staffs between the ages of 16 and 27 years were found to score higher on noise ($M = 4.1$, $p < .05$) and lower on overall satisfaction ($M = 2.1$, $p < .001$). Nurses more than 40 years old were found to score significantly higher on the importance of notification ($M = 3.5$, $p < .001$) and impact on overall satisfaction ($M = 2.6$, $p < .001$) than staff between the ages of 28 and 39 years. CNAs were found to score significantly higher on overall satisfaction (2.5 , $p < .05$) than LPNs. Staff working in the short-term unit scored significantly higher workload ($M = 3.99$) than the long-term unit ($M = 3.8$, $p < .05$) and the dementia unit ($M = 3.4$, $p < .05$). Staff working in the short-term unit also scored higher on the impact of noise ($M = 4.2$) than

the dementia unit ($M = 2.9$, $p < .001$) and long-term unit ($M = 3.9$, $p < .001$). The staff working on the evening shift gave higher scores for the impact of noise ($M = 4.0$), while the night shift ($M = 2.93$) scored significantly lower than the morning shift ($M = 3.83$, $p < .05$). The staff working on the evening staff scored significantly higher on the ease of locating a call light ($M = 3.83$, $p < .001$) than the morning shift ($M = 3.58$). The staff working on the morning shift scored significantly lower on the perceived utility of the call light ($M = 2.68$, $p < .05$) than the night shift. The staff working on the evening shift scored significantly higher on overall satisfaction (2.48 , $p < .001$) than both the morning and evening shifts ($M = 2.43$). Nursing home staff with more than 20 years of experience scored significantly higher on the ease of notification ($M = 3.58$) than staff between 10 and 20 years of experience ($M = 3.18$, $p < .05$) and staff with less than 10 years of experience ($M = 3.12$, $p < .05$). Staff with more than 20 years of experience scored significantly lower on overall satisfaction ($M = 2.25$) than staff between 10 and 20 years of experience ($M = 2.66$, $p < .05$) and staff with less than 10 years of experience ($M = 2.44$, $p < .001$).

Pearson correlation was used to measure the strength and direction of relationships between the domains. The results show a significant relationship whereby workload increases and satisfaction decreases when the ease of being notified as the ease of locating alarms, and the overall perception of call lights decreases ($p < .05$). Noise resulting from call lights has a significant correlation with the satisfaction level of the staff ($p < .05$). The ease of being notified has a significant negative correlation with the nature of call lights ($p < .05$). The ease of locating the different call lights has a significant correlation with the nature of call lights ($p < .05$).

Open-Ended Questions

Although responses to these questions were not part of a formal qualitative study, they were analyzed using qualitative techniques of coding to determine common themes among the responses from the participants.

Approximately 63% ($N = 66$) of the respondents answered the open-ended questions, 90% of these mentioned a form of noise-loud, annoying, and irritating to the staff and the residents. Around 78% of the respondents agreed that there are many alarms and this causes stress to them.

More than 49% of the respondents mentioned that the staff does not pay attention to call lights, 41% agreed that some residents do not know how to use it, and 72% agreed that residents use it for unurgent requests. Seven CNAs mentioned that they must make a trip to the nurse station to access the information about the call lights, around 37% mentioned that the console at the nurse

Table 3. Response Rate by Characteristics.

Characteristics	Domains					
	Workload	Noise	Easiness of being notified	Easiness of locating	Perception	Satisfaction
Gender	Mean response	Mean response	Mean response	Mean response	Mean response	Mean response
Male	3.42	4.60	3.32	3.45	2.43	2.10
Female	3.72	3.53	3.25	3.64	2.93	2.49
Job title						
CNA	3.69	3.66	3.23	3.62	2.83	2.48
LPN	3.71		3.11 (0.12)	3.62	3.03	2.39
Age						
16–27	3.8	4.1	3.3	3.8	2.5	2.1
28–39	3.8	3.5	3.0	3.7	3.1	2.6
40+	3.6	3.6	3.5	3.6	2.6	2.9
Unit						
Short	3.99	4.2	3.15	3.75	2.65	2.60
Long	3.81	3.92	3.45	3.75	2.84	2.37
Dementia	3.37	2.94	3.16	3.37	3.06	2.50
Shift						
Morning	3.83	3.83	3.32	3.58	2.68	2.48
Evening	3.61	4.00	3.33	3.83	2.81	2.48
Night	3.35	2.93	3.03	3.44	3.28	2.43
Experience (year)						
≤10	3.59	3.55	3.12	3.52	2.94	2.44
11–20	3.83	3.66	3.18	3.72	2.77	2.66
>20	3.75	3.79	3.58	3.70	2.63	2.25

Note. CNA = certified nursing assistant; LPN = licensed practical nurse.

station only shows the recent call light. Five CNAs agreed the system is outdated, but six CNAs agreed that there is nothing wrong with the call light system.

Around 92% of the staff agreed that implementing a system with the ability to track their response time would not reduce their time to respond. Moreover, around 32% of the staff mentioned that a system like that would cause more stress for them. In addition, 37% of the staff stated that they do not need anyone to track them because they know their job.

I know how to do my job; I don't need anyone to track me. (F, CNA, 40-45Y, evening shift, long-term care unit)

If we had enough staff response time might be quicker, but one person can't be in 2 places at once. (F, CNA, 34-39Y, morning shift, short-term care unit)

I don't think it will not make a difference. One person cannot answer four bells at one time. No one should be penalized for this reason. (F, CNA, 40-45Y, morning shift, dementia care unit)

I don't think it will improve response time because it does not tell you where the alarm is. (F, CNA, 28-33Y, morning shift, long-term care unit)

It will make me more stressed and not doing my job properly. (F, LPN, 28-33Y, evening shift, long-term care unit)

I don't feel it is necessary to time us on answering the call bell. There are other important issues that should be addressed. (F, CNA, 40-45Y, morning shift, dementia care unit)

Almost all the respondents to the third open-ended question feel like their behavior would not change when implementing the system. However, 64% think that other CNAs and LPNs behavior would change because of the pressure the system will add, and the staff will tend to cancel alarms without assisting residents.

Yes, I think people will be scared so they might do this (she means to cancel the alarm without assisting the residents). (F, CNA, 17-21Y, evening shift, long-term care unit)

Yes, it will change staff behavior, we will feel more pressure. (F, CNA, 34-39Y, evening shift, long-term care unit)

Yes, because we wouldn't want to get penalized about not answer a call bell when we're in with someone. (F, CNA, 17-21Y, evening shift, long-term care unit)

Discussion

A survey instrument was designed to capture the end-user experience of nursing home staff using the call light

Table 4. The Kruskal–Wallis Test and Dunn Post Hoc Test Results.

Demographics	Domains	Demographic levels	df	χ^2	Kruskal p value	Dunn Post hoc
Gender		Male/female				Adjusted p value
Levels	Workload		1	0.271	.603	
0: Female	Noise		1	10.782	1.025E–03	1–0: .001024
1: Male	Notification		1	2.769	.096	
	Location		1	6.406	1.138E–02	1–0: .01137635
	Perception		1	2.057	.152	
	Satisfaction		1	4.007	.045	1–0: .0453
Age		Level 1/Level 2/Level3				
Levels	Workload		2	0.019	.991	
1: 16–27	Noise		2	10.099	.006	1–2: .0055
2: 28–39	Notification		2	17.982	1.246E–04	2–3: .0001003
3: 40+	Location		2	0.907	.635	
	Perception		2	3.959	.138	
	Satisfaction	CNA/LPN	2	34.021	4.097E–08	1–2: 2.34711e–04 2–3: 2.37941e–07
Title						
Levels	Workload		1	0.018	.893	
0: CNA	Noise		1	0.177	.674	
1: LPN	Notification		1	0.269	.604	
	Location		1	3.779	.052	
	Perception		1	1.800	.180	
	Satisfaction		1	8.197	.004	1–0: .004196935
Unit						
Levels	Workload		2	8.256	.016	3–2: .0458 3–1: .0402
1: Short term	Noise	Short/long/dementia	2	25.813	2.481E–06	3–2: 5.614e–05 3–1: 3.528E–05
2: Long term	Notification		2	0.667	.717	
3: Dementia	Location		2	1.760	.415	
	Perception		2	2.961	.228	
	Satisfaction		2	1.327	.515	
Shift		Morning/evening/night				
Levels	Workload		2	2.392	.303	
1: Morning shift	Noise		2	17.465	1.613E–04	3–1: .02413401
2: Evening shift	Notification		2	3.816	.148	
3: Night shift	Location		2	19.308	6.417E–05	2–1: 3.342083e–05
	Perception		2	7.083	2.898E–02	1–3: .0241
	Satisfaction		2	13.317	1.283E–03	2–3: .000789
Experience		1/2/2003				
Levels	Workload		2	1.400	.497	
1: $x < 10$	Noise		2	3.224	.200	
2: $20 > x > 10$	Notification		2	6.353	.042	1–3: .031 2–3: .015
3: $x > 20$	Location		2	2.954	.228	
	Perception		2	3.464	.177	
	Satisfaction		2	15.129	5.185E–04	1–3: .000144 2–3: .00622

Note. CNA = certified nursing assistant; LPN = licensed practical nurse.

system and to explore the process of how nursing staff feedback is incorporated into the decision-making process by nursing home administrators in purchasing and implementing a new call light system. The survey includes sections for respondents to include short answers using this qualitative approach has enriched

the data collection as the staff could share their experience and thoughts, which helped to explain trends in the questionnaire results. Six dimensions such as workload, noise, ease of notification, ease of location, the nature of call lights, and overall satisfaction were used to understand nursing home staff's perceptions about the use of

call light and the nature of call lights, to investigate the effect of the newly proposed call light system, and if there are negative perceptions that manifest any negative attitudes and behavior that contribute to the poor performance (long response time) and acts as barriers in delivering a quality of care.

In this study, ease of being notified and the ease of locating call lights were found to have a significant correlation with the workload. This can be explained by the many usability challenges in the current system. For example, the call light system display is not accessible to the nurse away from the nurse station. Furthermore, the current system does not provide feedback information about the nature of the emergency or the resident's room number. The staff has also mentioned many broken parts that could also contribute to the high workload by increasing the false alarm rate and the redundancy of work.

Furthermore, the study determined there were differences in nursing home staff perceptions of noise, workload, and overall satisfaction caused by experiences with the call light system along with demographic factors, and that some of these differences were significant along with the levels of these factors. For example, the study finds that the nursing home staff assigned to the short-term care unit reported greater workload and noise than long-term care unit staff. While the short-term care unit will experience multiple changes each month in the location and status of nursing patients, causing higher workloads as they constantly adapt to changing patient treatments. This, in conjunction with short-term residents tending to have higher acuity, results in nursing home staff perceiving more frequent call light alarms. In addition, older CNAs tended to give a higher score for notification and overall satisfaction, suggesting that their experiences with the call light pose a greater impact on their job performance as well as their overall job satisfaction. Age becomes a greater attribute of a wide variety of conditions such as vision and hearing deficits, increased tiredness, more complex professional roles, and a sense of not being valued in the context of greater perceived workload (Fragar & Depczynski, 2011).

Regarding job title, CNAs were found to score significantly higher on overall satisfaction than LPN, suggesting that the usability of the call light system poses a larger perceived impact to CNAs than LPNs. This perception likely stems from common nursing home policies requiring CNAs to always respond to alarms, and this includes multiple CNAs visiting the same resident's room. While all nurses are technically required, because CNAs account for nearly 80% of the staff, their workload usability demands regarding the call light system are reasonably higher due to the greater usage rate compared with LPNs, who are fewer in number and are usually tasked with administrative tasks.

The study found that a high rate of alarms and broadcasting call light at the nurse station area contributes to alarm fatigue, which contributes to workload. This results from two growing trends in nursing home settings: the aging nursing home staff and the dominance of nonemergency call light notifications. The study shows that over 30% of the observed nursing home staff were more than 40 years old, which our tests linked to respondents perceiving impacts of noise, ease of notification, and overall satisfaction regarding the call light system. Furthermore, the staff agreed that most users of the call light system involve nonemergency concerns, which is consistent with the Lasiter's (2014) study, in which most calls were requests for position change, followed by toileting assistance, and accidental calls. This, in conjunction with the perception of *noise* due to the high volumes of alarms and low user satisfaction with the call light, contributes to alarm fatigue, as nurses learn to *tune out* the alarm if they stop perceiving the alarm to be meaningful.

The study recognizes a temporal factor when observing the call light system. Shift timing has a significant effect, as there are very few call lights during the night shifts. The study finds that most residents are asleep by 9:00 p.m. Furthermore, most residents are aided to sleep by sleep medications, pain medications, or their overall fatigue due to aging. As a result, nursing home staffs working during the night shift have fewer opportunities to use the call light system once the residents have gone to sleep.

The staff mentioned that their call light system could only display the most recent alarm. This means that multiple call lights can override the previous alarm, without providing any information to identify which of these alarms have been resolved. The prioritization process itself is found to contribute to a high mental workload (Deitrick et al., 2006; Meade et al., 2006; Roszell et al., 2009; Tzeng, 2011b). As nursing home staff have limited information when receiving call light notifications, they also have a highly limited rationale with which to make decisions (Deitrick et al., 2006; Meade et al., 2006; Roszell et al., 2009). The study finds that this lack of information limits the nursing home staff's ability to prioritize tasks. This is found to make their job more difficult, as they are unable to assess the severity and urgency of the patient's request that call light is not meaningful, and 62% believes that residents do not use for urgent needs, and it is not meaningful (Tzeng, 2011a). Approximately 78% agreed that responding to a call light can prevent serious harm (Roszell et al., 2009; Tzeng, 2011a). The notes of the study indicate that experience addressing important call lights help to increase the perceived effectiveness of the call light system. Furthermore, multiple false alarms or nonemergency alarms help to cause the opposite to occur. These

findings coincide with the breakdown of nonemergency call lights, suggesting that alarm fatigue is connected to the inability of nursing home staff to prioritize more meaningful call lights.

Studies debate over whether workload redundancies improve the overall response time to individual patients by ensuring more than one staff member is prompted (Meade et al., 2006) or whether these redundancies further choke up the already chaotic nature of the call light system (Lasiter, 2014). Our study found workload redundancy as it relates to call light systems as detrimental to the perception of its uses by nursing home staff. CNAs mentioned broken parts when they cancel the alarm from the resident's room, but the auditory alarm at the nurse station remains active, which can cause redundancy of work, and that contributes to increasing the workload.

This study reveals that the staff overall is not satisfied with the way the call light system works and that the long response time to the call light is caused by the many usability issues associated with the system. Consistent with the literature (Deitrick et al., 2006; Meade et al., 2006; Roszell et al., 2009; Tzeng, 2011b), aside from the nurses station that must always be staffed, the call light system possesses no interface accessible to staffs who are often working inside the residents room most of the time. In addition, the system contributes to workload, as the current system does not provide enough information about the patient, creating occurrences that contribute to increasing workload, such as redundancies of work, false alarms that can contribute to alarm fatigue. Finally, the study finds glaring problems in the equipment, such as many broken parts, parts are not visible (blocked by beams and doors).

In short, the nursing home administration planned to replace the call light system with one that could track the response time; however, our research suggests that it may do more harm than good. Placing additional performance measures on nursing home staff, while failing to incorporate their user feedback could further alienate nursing home staff from adopting new call light technology in the future. The staff was able to provide meaningful information and feedback about their experience. These perceptions helped to shape the insights found in our study, suggesting that the usability issues in the design of call lights may be caused by traits in the traditional nursing home's organizational culture. Organizational culture shapes the way that employees conduct their work and treat their patients. The nursing home's patient safety culture, leadership, managers, and executives all influence the way that nursing home staffs perceive how meaningful call lights are (Tzeng & Yin, 2014).

Conclusion

The study finds that current usability challenges in the call light system limit the ability of nursing home staff to work effectively. By acquiring a new call light system with the intention of tracking response times, the administration may exacerbate the already negative perceptions of the call light system as well as its effect to the staff's increasing workload and declining overall satisfaction. To improve the quality of the call light system, future upgrades to the current system must reflect the usability demands and workload concerns of the nursing home staff.

Limitation

As the study collected the responses of a single nursing home, certain demographic conditions, while significant, most likely have greater nuances in their significance at a larger sample, more varied sizes. Future studies that further test for nuances in the differences found in levels of demographic factors will employ more comparative tools, such as measuring the ratio of the number of nursing staff (CNA and nurse) per how many residents and comparing them with the national standard.

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