

RESEARCH ARTICLE

A Descriptive Analysis of Factors that Influence Adoption of Automated Pupillometry

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Abstract

Background: By current estimates, it takes 17 years to adopt a new evidence-based practice (EBP) intervention. Nursing efforts to increase EBP adoption typically focus on education. But, there is a research gap in that there is a lack of evidence to support that education impacts the adoption of evidence-based practice. This study explored factors associated with adopting quantitative pupillometry (QP).

Methods: This longitudinal, retrospective study used registry data to calculate QP usage rates between 2015 and 2021. Events and interventions hypothesized to increase EBP adoption were identified through stakeholder interviews and literature search. Events were categorized as: conference presentations, publications, education, new study sites, QP adoption on other nursing units, equipment purchase, and policy changes. Scatterplots and Spearman's Rho were used to examine the relationship between time and usage rate of QP. Odds ratio analyses were conducted to explore the relationship between the selected event types and changes in usage rate from month-to-month.

Results: Using 74,428 QP observations from 3,976 patients, there was a significant positive relationship between usage rate of QP and time ($r = .642$, $P < .0001$). However, there was no statistically significant odds of any event-type (alone or in combination) impacting the rate of QP adoption.

Conclusion: Time was the only independent variable significantly associated with an increase in EBP adoption for this intervention. Common methods used to accelerate nursing adoption of EBP may have limited effect.

Introduction and Background

Current estimates are that it takes up to 17 years for a new innovation to be adopted into practice (Balas & Boren, 2000). As of September 2022, the evidence supporting quantitative pupillometry (QP) exceeds 1,000 articles. QP is a prime example of an evidence-based practice (EBP) intervention that has been consistently shown to be superior to traditional practice (Al-Obaidi et al., 2019; Couret et al., 2016; Emelifeonwu et al., 2018; Kerr et al., 2016; McNett et al., 2017; Oddo et al., 2018; Olson et al., 2016; Riker et al., 2020; Zhao et al., 2016). Despite these findings, adoption of QP is sluggish and manual use of penlights or flashlights to assess the pupillary light reflex (PLR) remains standard-of-care in most facilities (Anderson et al., 2018; Lee et al., 2018). There is a pressing need

for research that examines how education might influence adoption of new EBP innovations (Bautista et al., 2022). The purpose of this study is to address this literature gap by exploring interventions which are commonly hypothesized to increase adoption. The vehicle to explore EBP adoption is adoption of QP in the neuroscience intensive care unit (NSICU).

A new intervention, process, or medication which is demonstrated to be effective in randomized clinical trials is of little benefit to patients unless and until it is adopted into clinical practice (Castro-Palaganas, 2022; Tamayo, 2019). Despite the increased emphasis on adopting evidence-based practice (EBP) in nursing, well-developed studies and systematic

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reviews on the effectiveness of the most common adoption strategies are limited (Arde, 2020; Rose Bovino et al., 2017). The translation of findings into clinical practice remains slow, spanning from years to decades (Melnyk & E., 2011). The field of implementation science aims to accelerate adoption of EBP interventions (Bauer & Kirchner, 2020; Dykes et al., 2021).

Educational efforts are often used as a major component of any effort to implement a new, or newly revised EBP intervention (Cassman et al., 2021; Drollinger & Prasun, 2023). Educational efforts such as train-the-trainer, simulation-based education, and online educational platforms are often touted as interventions that can be leveraged globally and across resource limited settings (McGushin et al., 2023). Education is important to developing knowledge, and education has long been recognized as playing an important role in adopting EBP (Youngblut & Brooten, 2001). Nurses must be able to identify the meaning and reason behind their actions. In this manner, education can often be viewed as a low-cost high-yield intervention. Yet, there are renewed calls for identifying sources of knowledge development in nursing beyond didactic educational efforts (Smith et al., 2021).

The accuracy and early detection of pupil changes carry significant implications for clinical practice (Emelifeonwu et al., 2018; Lussier, Olson, et al., 2019; Olson et al., 2017; Phillips et al., 2019). A 2016 study conclusively found that subjective PLR measurements estimating pupil size and reactivity using a flashlight or penlight manually are unreliable (Olson et al., 2016). Evidence also supports that even if subjective estimates were reliable, they would not provide adequate information about PLR function (Privitera et al., 2022; Shoyombo et al., 2018). QP has been repeatedly demonstrated to be more accurate, reliable, and informative than subjective assessment (Cortes et al., 2021; Dance et al., 2020; Giamarino et al., 2021; Lussier, Stutzman, et al., 2019; Martineau-Lessard et al., 2022; Olson & Fishel, 2016). However, despite being commercially available for over 20 years, QP technology is not yet fully adopted into clinical practice (Anderson et al., 2018; Lee et al., 2018). The NSICU at our facility began using QP in 2015, and there have been multiple attempts to improve nursing adoption of QP including education, policy, and increased access across multiple units.

Methodology and Methods

This longitudinal, retrospective study includes data from an international registry called "END-PANIC" (Olson et al., 2017) that includes QP related variables from over 6,000 patients from 4 North American, 1 Asian, and 1 European institution (clinicaltrials.gov #NCT02804438). The registry and study procedures received Institutional Review Board approval and ethics approval from all participating institutions. To enhance

internal validity, this analysis only includes patients admitted to the NSICU of the primary coordinating facility between October 2015 and June 2021 (68 months).

Events hypothesized or designed to impact adoption (hereafter 'adoption events') were identified by interviews with stakeholders and then categorized into 7 types: conference presentations, publications, education, new study sites, QP adoption on other nursing units, equipment purchase (additional pupillometers), and QP policy changes (Table 1). Conference presentations were defined as a platform presentation (lecture) or poster (electronic or print) presentation at a national or international conference that focused on QP and was attended by at least one NSICU nurse. Publications were included if they were peer-reviewed, focused on QP, and there was at least one NSICU nurse listed as an author on the publication. Education was defined as educational events aimed to provide QP knowledge, held at our institution, and attended by UTSW staff. Education could be provided by nurses, physicians, or industry sponsored, but was required to be a scheduled event (e.g., teaching during orientation would not count as an education event). New study sites were only included if they were approved by institutional review boards of their respective institution to share QP data with the UTSW END-PANIC registry. QP implemented on other nursing units is an event that is defined as formal introduction of QP on a nursing unit at our institution other than the NSICU. For example, when the medical-surgical intensive care unit was trained-on, and began using pupillometers as standard-of-care, that counted as an implementation event. Additional pupillometers was scored as an event if our hospital purchased, and began using, additional pupillometers. This had to result in additional devices being available for nurses to use. Replacing or upgraded pupillometers did not count as an event. QP policy changes was defined as unit-specific changes in written policies that specifically addressed the use of pupillometers. For example, when the NSICU adopted the policy that pupil exams would be done with pupillometers instead of with a penlight. The type of each adoption event and the month in which it occurred were then entered into the dataset.

The NSICU policy at the primary site is to assess PLR using QP at least once every 4 hours (6 times per day). Using this as a standard, the QP usage rate for each patient was derived as the actual number of QP readings taken during the patient's NSICU hospitalization, divided by the total number of expected QP readings (6 per day times the number of NSICU days). Using this formula, usage-rate falls between 0 and 1, where a value of 0 indicates no QP readings were obtained, and a value of 1 indicates ≥ 6 QP readings per day.

Table 1. Type and number of pupillometer adoption events

QP adoption events	Number of adoption events	Months with ≥ 1 adoption events
Conference presentations	14	12
Publications	20	17
Education	11	9
New study sites	4	4
QP implemented on other nursing units	2	1
Equipment purchase (additional pupillometers)	4*	4
QP policy changes	2	2
Total	57	**

* Refers to the number of times additional pupillometers were purchased, not the number of additional pupillometers.

** A total value is not provided because any 1 month could have multiple events.

Next, the mean usage rate for each month was derived by taking the average of all the patients admitted to the NSICU during the same month and year. Statistical models were then constructed to examine mean monthly usage rates over time for each of the 7 adoption events individually, and collectively. A minimally significant difference was defined as an increase or decrease > 0.5 standard deviation of the monthly usage rate (Norman et al., 2003).

Data were uploaded into SAS v9.4 (SAS Institute) for analysis and are reported as mean (standard deviation) or frequency (percent) unless otherwise noted. Odds ratio models were constructed to examine relationships between adoption events and usage rate changes. Spearman's Rho was used to test for a significant relationship between usage rate and time. Partial correlation models were created to explore variables hypothesized to significantly impact the relationship between usage rate and time.

Findings

From 4,371 patients in the registry, 3,976 were ≥ 18 years of age with a documented NSICU length of stay ≥ 1 day. These records provided 74,428 QP readings (Table 2). Interviews with the nurse manager, the research team, the unit-based educator, and the corporate educator revealed 57 adoption interventions occurred during the 68 months. Figure 1 indicates that although there was an overall increase in QP usage over time ($r = .642$), there was no readily discernable pattern of increase. Because the sample did not meet the assumptions of normality, Spearman's Rho modeling was used to confirm a statistically

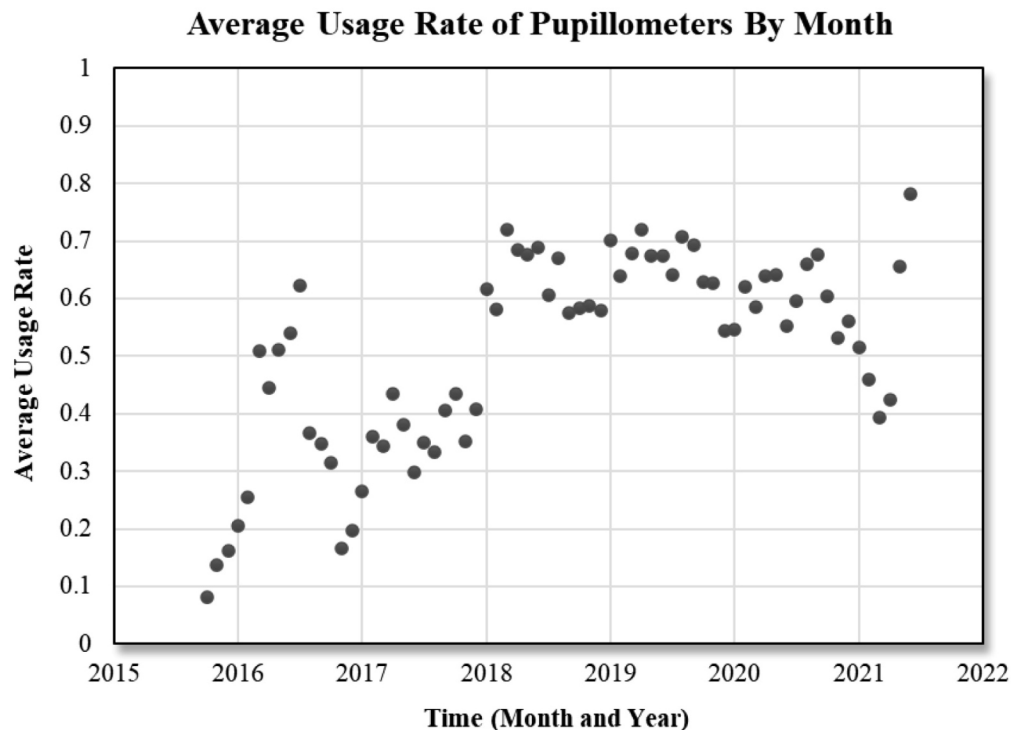
significant relationship between usage rate and time ($P < .0001$). In univariate linear regression models, the following variables were significantly associated with QP usage: patient age ($P = .001$), lower NPi scores ($P < .0001$), higher National Institute of Health Stroke Scale (NIHSS) scores ($P < .0001$), lower Glasgow Coma Scale (GCS) scores ($P < .0001$), and longer NSICU length of stay ($P < .0001$). The gender, race, and ethnicity of the patient were not significantly associated with usage rate ($P = .5662$, $P = .9844$, and $P = .0547$, respectively). Partial correlation tests revealed that after controlling for all demographic variables, the relationship between usage rate and time remained statistically significant ($P < .0001$).

Table 2. Demographic data for 3,976 patients

Variable	Statistic
Sex	
Female	2134 (53.67%)
Male	1842 (46.33%)
Race	
African American	598 (15.04%)
Asian	131 (3.29%)
Caucasian	2832 (71.23%)
Native American/Pacific Islander	10 (0.25%)
Other/Missing	405 (10.15%)
Ethnicity	
Non-Hispanic	3364 (84.61%)
Hispanic	497 (12.50%)
Other/Missing	115 (2.89%)
Age	56.28 (16.94)
Pupil score for left eye (NPiL)	3.87 (1.19)
Missing	6163 (8.28%)
Pupil score for right eye (NPiR)	3.87 (1.15)
Missing	5012 (6.73%)
Injury severity on admission (GCS)	
Mild brain injury	3006 (75.60%)
Moderate brain injury	419 (10.54%)
Severe brain injury	485 (12.20%)
Missing	66 (1.66%)
Stroke severity on admission (admiNIHSS)	
No stroke	273 (6.87%)
Mild stroke	299 (7.52%)
Moderate stroke	324 (8.15%)
Moderate-to-severe stroke	147 (3.70%)
Severe stroke	234 (5.89%)
Missing	2699 (67.88%)

Note: Values are reported as mean (standard deviation) or frequency (%).

Figure 1. Scatterplot of average usage rate over time



Note: Each dot represents the average usage rate of all patients admitted during the same month, and the first dot marks October 2015. A usage rate of 0 represents 0% usage of QP, and a usage rate of 1 represents 100% usage.

Table 1 provides an overview of the type and frequency of the adoption events. The most frequent adoption event included oral and abstract conference presentations (14), presented by NSICU faculty and attended by nursing and medical staff. There were 11 didactic educational events held for the NSICU nursing staff, and 20 peer-reviewed publications were published by multidisciplinary teams from the NSICU. Additional events include adding new hospitals to the registry (4), other nursing units at our hospital adopting and being educated on pupillometer use (4), purchasing new equipment (the NSICU purchased additional pupillometers on 4 different occasions and there is now a pupillometer in every NSICU patient room), and 2 policy changes specifically related to QP use; the first requires QP measurements on all patients at least once every 4 hours; the second is that NSICU staff should avoid use of a penlight or flashlight and all PLR assessments should be done with QP devices.

As shown in Table 3, models constructed for odds ratios found that there was a lower likelihood of an increase in QP usage rates during the month when a nurse or physician presented about QP at a national conference (OR=0.11; 95%CI=0.01-

0.93; $P<.05$); but this was not a predictor of a sustained decrease in QP usage rate (OR=1.51; 95%CI=0.42-5.41; $P<.529$). There were no other events, either alone, or in combination, that were associated with a statistically significant change in monthly usage rate of QP (Table 3).

Discussion

Despite significant efforts to alter the rate of adopting an EBP intervention (in this case, adopting QP over subjective assessment of PLR with a flashlight), time remains the only independent predictor of increased adoption. Knowledge, in and of itself, is insufficient to change nursing behavior (Arlinghaus & Johnston, 2018). While this study specifically explored adoption of QP, the findings are relevant to the adoption of other clinical innovations. The results are consistent with the Diffusion of Innovations theory which posits that time is the key factor associated with an innovation's rate of adoption (Rogers, 2003). Very few innovations are instantaneously adopted. Often, it takes time for users to discover and then make judgements regarding EBP

Table 3. Results of the odds ratio analyses

Adoption event	Significant increase in monthly usage rate			Significant decrease in monthly usage rate		
	Odds ratio	95% CI	P value	Odds ratio	95% CI	P value
Conference presentations	0.11	0.01 - 0.93	.043	1.51	0.42 - 5.41	.529
Publications	0.60	0.18 - 1.94	.390	0.76	0.23 - 2.51	.658
Education	1.35	0.33 - 5.55	.681	0.98	0.22 - 4.31	.973
New study sites	0.52	0.05 - 5.28	.580	2.05	0.27 - 15.56	.489
QP adoption on other nursing units	0.52	0.02 - 13.30	.694	6.07	0.24 - 154.95	.276
Equipment purchase (additional pupillometers)	5.35	0.53 - 54.42	.157	0.64	0.06 - 6.48	.703
QP policy changes	1.64	0.10 - 27.41	.731	0.37	0.02 - 8.04	.527
At least 1 event	0.53	0.20 - 1.42	.206	1.36	0.49 - 3.78	.554
Exactly 1 event	0.49	0.17 - 1.42	.189	2.03	0.72 - 5.70	.179
Exactly 2 events	0.78	0.18 - 3.44	.746	0.52	0.10 - 2.72	.436
Exactly 3 events	8.67	0.40 - 188.13	.169	0.37	0.02 - 8.04	.527
Exactly 4 events	0.31	0.01 - 6.62	.450	2.00	0.12 - 33.51	.630

innovations before incorporating those innovations into their daily practice (Dyb et al., 2021; Rogers, 2003).

The results have significant implications to clinical practice in that they reinforce the need for implementation science research, and suggest that despite conventional wisdom, educational events may not be a key factor in adopting evidence-based practices (Moreno-Lacalle, 2018). A common narrative in nursing literature is that education drives adoption of EBP (Dyb et al., 2021; Pashaeypoor et al., 2016). And clearly, education is an important step in implementation science. However, while we found that EBP adoption (as evidenced by increase QP use) did significantly increase over time, our analysis failed to identify any event, alone or in combination, that directly influenced the rate adoption.

The findings from our study build upon prior literature. One study concluded that continuous targeted education over time that is supplemented by hands-on training is required to support adoption of new EBP interventions (Duff et al., 2020). In our study, despite being provided with didactic education about QP roughly twice per year, education did not influence adoption of

QP even though our education events included targeted hands-on training. Similar to our findings, a study of 120 nurse faculty members did not include 'being educated about the device' as a factor driving adoption of mobile technology (Forehand et al., 2021). Educational efforts that emphasize the key advantages of the innovation and a simplified 'less is more' approach to education may be more effective in promoting adoption (Mohammadi et al., 2018).

Specific implementation science drivers need to be identified (Bauer & Kirchner, 2020). The nurses' perception of an EBP innovation's usability may be a stronger driver of adoption than education (Kitzmiller et al., 2019). Automated integration of QP readings into the electronic medical record (EMR) would be expected to improve the accuracy and the workflow efficiency by reducing documentation time; and thus, EMR integration may promote adoption due to its relative advantage (Tran et al., 2022). Implementation science supports that identifying and incorporating stakeholders may promote adoption (McNett et al., 2019). Policy changes, equipment purchasing, and facilitating educational events all required buy-in from the unit-based council (of nurses), the NSICU management team, and

the physician team members who admit patients to the NSICU. In this manner, we had a measure of stakeholder buy-in. NSICU nurses and physicians were also stakeholders in that they collaborated on peer-review publications and conference presentations (e.g., scientific abstracts). Surprisingly, conference attendance was associated with lower odds of observing an increase in QP usage rates during the month following the conference (Table 3). It may be that the novelty of the event has waned after the conference, but additional research is needed to determine if this is a spurious finding.

Limitations

Our decision to examine rate change as a monthly event may limit generalizability of the findings. If an event occurred at the beginning of a month, there may have been a short-term increase in usage rates as a result of the event. But, the event itself may have required multiple months in preparation during which a Hawthorne-type effect may have influenced the rate of change. For example, a policy change may require over 6 months to complete and would have been discussed by all the staff, written by the unit-based council, and announced at staff meetings before the policy actually became effective. The advantage to examining monthly rate change is reducing the risk of a novelty bias, and being more apt to examine sustainable change (Seehra et al., 2021). There are likely some patients with exceptionally high usage rates. For example, our results found that higher NIHSS scores, and lower GCS scores, (indicative of a more critically injured patient) were predictors of higher QP usage. However, we suggest that our extremely large sample size had very few outliers and thus provided an accuracy of estimating usage rates across the 68 months. It is also a limitation that adoption events were not mutually exclusively. There were months during which multiple adoption events simultaneously (e.g., an education event was held during the same month that a policy change went into effect). Although this was rare and we were not powered to detect a statistical difference, multiple events did not appear to influence usage rates (Table 3).

Conclusion

This study is important because it sheds new light on the assumed benefits of educational interventions as a method to promote EBP adoption. Education is one of the most common events employed to increase the adoption of EBP innovations. The nihilism of waiting 17 years for an innovation to become standard of practice is not acceptable; particularly in the presence of compelling evidence of the innovation's clinical advantages and improved patient outcomes, as with QP. Although there was a clear increase in adoption of QP over the course of 68 months, none of the events we examined appears to have influenced the overall rate of adoption. The results

provide direct insight for other nursing organizations adopting QP and generalized insight towards EBP adoption interventions for a multitude of other EBP innovations. The rapid pace of change demands that nurses discover and adopt EBP interventions to promote best practice. Although time (years) remains the most significant predictor of EBP adoption, nurse researchers must discover novel mechanisms to promote EBP. These findings provide valuable insight towards future implementation science research.

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RESEARCH ARTICLE

Evidence-Based Practice Competency, EBP Beliefs and Research Utilization among Ghanaian Nurses: A Mediation Analysis

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Abstract

Purpose: The disparity between conducting research and putting it into practice has remains a global healthcare issue, with less than 50% of nurses utilizing research. This study aims to determine the level and relationship between Evidence-based practice (EBP) competency, current EBP beliefs and research utilization among nurses.

Design and Methods: This quantitative study utilized a descriptive-correlational design and mediation analysis. A purposive sampling was used to select six Christian Health Association of Ghana (CHAG) hospitals. Simple random sampling was used to recruit 544 nurses from the six CHAG hospitals. The study utilized mean and standard deviation, Pearson Correlation, ANOVA, and GLS mediation analysis. The researcher obtained ethical approval from the Saint Louis University Research Ethics committee and, the institutional review board of the CHAG.

Findings: The results showed that nurses had a low level of EBP competency ($M=2.27$, $SD=0.255$), strong positive EBP beliefs ($M=2.58$, $SD=0.322$) and low research utilization ($M=2.57$, $SD=0.300$). There was a moderately significant positive relationship between EBP competency and research utilization ($r=.431$, $p=.000$), EBP competency and EBP beliefs ($r=.327$, $p=.000$) and EBP beliefs and research utilization ($r=.306$, $p=.000$). There is no significant difference in terms of EBP competency and research utilization when EBP training attendance was considered. Nurses with 1-2 years of experience had a higher level of EBP competency. Theatre nurses had a higher level of EBP competency, however, emergency nurses had a lower level of research utilization than nurses in the surgical unit. EBP beliefs mediated the relationship ($B=0.0604$, $z=3.99$, $p<.001$) between EBP competency and research utilization.

Conclusions: Nurses in CHAG hospitals have a limited ability to implement the EBP process. The respondent perceived the value of EBP in nursing practice to be significant and has the confidence to implement the EBP process. The nurses' respondents use of research in nursing practice is limited due to the organizational barriers in CHAG institutions in Ghana. Based on the findings, it is recommended for nurse administrators and policy makers to prioritize the provision of adequate resources, support, EBP policies and targeted training programs to facilitate a culture of evidence-based practice and research utilization in CHAG institutions. By improving EBP competency and promoting research utilization, nurses can enhance the quality and safety of patient care.

Keywords: *Evidence-based practice, Competencies, Research utilization, EBP beliefs*

Introduction

Nurses are one of the primary utilizers of research in practice to promote patient safety (Majid et al., 2011). Joyce and Cartwright (2019) emphasized that the disparity between conducting research and putting it into practice has become a

global nursing issue that has drawn the attention of international health organizations. In response, the International Council of Nurses (ICN), American Nurses Association (ANA) and The Institute of Medicine (IOM)

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established goals and guidelines for healthcare decisions to be backed by accurate best available evidence that is up-to-date. Despite the efforts of international health organizations, Duff et al. (2019) determined that less than 50% of nurses utilize research in nursing practice. McGinnis et al. (2009) identified that most evidence used in practice was beyond 17 years old.

In this study, evidence-based practice (EBP) competency is operationally defined as an individual's perceived personal cognitive, psychomotor, and affective ability to implement the EBP process. Studies reported in different settings have shown varied nurses' levels of evidence-based practice competency. In public teaching hospitals (Atakro et al., 2020 & Camargo et al., 2018) and hospitals with adequate EBP support (Aynalem et al., 2021 & Dereje et al., 2019) nurses possessed a moderate to a high level of EBP competency. On the contrary, studies conducted in public hospitals (Assefa & Shewangizaw, 2021; Fu et al., 2020; Melynck et al., 2017; Verloo et al., 2016) and hospitals in rural settings (Yiridomoh et al., 2020) suggest that nurses had a low level of EBP competency due to a lack of internet access, technological competence, and managerial support.

EBP belief is an individual factor influencing research utilization into practice and EBP implementation. EBP beliefs in this study are operationally defined as an individual perception EBP value and the confidence to put the EBP process into practice. Previous literature suggests that nurses believe positively about EBP (Arde, 2018; Pereira et al., 2018; Verloo et al., 2016). However, other studies have also concluded that nurses negatively believe in EBP (Gifford et al., 2018; Vehviläinen-Julkunen, 2016). Gifford et al. (2018) concluded that nurses in lower-income countries believed that EBP could only be utilized when there is a clinical problem but not as a daily practice. Possessing a positive or negative belief towards EBP can influence research utilization in practice.

Research is the foundation of safe and quality nursing care (Abujaber & Nashwan, 2018). This study defines research utilization as an individual's use of research-based knowledge in nursing practice. Previous studies suggest that nurses in teaching hospitals have a high level of research utilization in their nurse's practice. This claim is supported by the study of Kyalo et al. (2015), where 70.5% of nurses utilize research in their nursing practice, and Sanluang and Aunguroch (2016), where research is used among nurses in Thailand, was moderate. The high level of research utilization among nurses in teaching hospitals is attributed to the resources and research culture of the institutions.

However, in public hospitals, Dagne and Tebeje (2021) and Kousar et al. (2017) concluded that nurses showed low research utilization in nursing practice. The authors noted that non-

intentional research utilization was a common practice among nurses. This conclusion suggests that most nurses are unaware when their practice is guided by research.

In Africa, Ghana has one of the lowest rates of research utilization among nurses. Approximately 54% of nurses in Zambia, 30.9% of nurses in Nigeria, and only 25.3% of nurses in Ghana integrate research into their practice (Aynalem et al., 2021). Fu et al. (2020) proposed that nurses' EBP competency and EBP belief may be a precondition for effective research utilization in the clinical setting. However, reviewing past literature has provided conflicting results on the influence of evidence-based practice competency on research utilization (Kim et al., 2015; Skela-Savič et al., 2017). Moreover, previous studies have focused on EBP competency and beliefs towards the implementation of EBP (Cruz et al., 2016; Pereira et al., 2018), with a lack of focus on EBP competency and research utilization when mediated by EBP beliefs.

The empirical evidence from this study will contribute to nursing practice, administration, research, policies, and education. It will provide nurses with valuable insights into their beliefs, competency, and practices, serving as an indicator of progress in EBP competency and research utilization. Nurse administrators in CHAG institutions will gain knowledge on the resources and support needed to promote research utilization. Policymakers can use the study results to understand EBP competency, beliefs, and research utilization among nurses and develop institutional policies accordingly. The study will also fill the gap in understanding the influence of EBP competency and beliefs on research utilization. For nursing education, the findings will guide educators in incorporating activities that foster students' interest in research and EBP, preparing them for their transition into nursing practice.

Therefore, this study sought to determine the level of EBP competency and beliefs and its relationship with research utilization among nurses.

Methods and Procedures

Research Design. This quantitative study utilized a descriptive-correlational design with mediation analysis.

Locale and Population. Ghana is located in the western part of Africa. The researcher used the purposive sampling technique to choose six Christian Health Association of Ghana (CHAG) hospitals from six major regions: Ashanti region, Greater Accra region, Bono, Bono East region, Ahafo Region, and Northern region of Ghana.

Furthermore, the researcher used simple random sampling to recruit 544 respondents nurses from CHAG Hospitals in the six selected regions in Ghana. The respondent's inclusion criteria

Table 1. Work Related Variables of Respondents

	Demographic	Frequency	Percentage
Years of Experience			
	1-2 Years	257	47.2 %
	3-5 Years	164	30.1 %
	6-9 Years	88	16.2 %
	10 Years and Above	35	6.4 %
EBP Training			
	None	262	48.2 %
	1-2	176	32.4 %
	3-5	86	15.8 %
	6 and above	20	3.7 %
Clinical Unit of Assignment			
	Medical Unit	173	31.8 %
	Theatre Unit	50	9.2 %
	Maternity Unit	46	8.5 %
	Emergency Care Unit	95	17.5 %
	Surgical Unit	120	22.1 %
	Intensive Care Unit	60	11.0 %

were: full-time nurse employee of the selected hospitals and the nurse must have at least one year of working experience. The respondent's exclusion criteria were: nurse administrators, a part-time employee, a float nurse in the current unit, nurses with less than one year of working experience.

The demographic profile of the respondents in terms of the years of experience, the number of EBP training attended, and the clinical unit of assignment are described in table 1.

Data Gathering Tools. This study adopted the Evidence-Based Practice Competency Questionnaire Professional version (EBP-COQ Prof), a standardized tool developed by Ruzafa-Martínez et al. (2020). The EBP-COQ Prof tool had internal reliability with a Cronbach alpha of 0.8.). In this study, the EBP-COQ Prof yielded a Cronbach alpha of 0.859. The respondents rated each item using a 5-point Likert scale from strongly agree to strongly disagree.

The study adopted the EBP Belief Scale, a standardized self-assessment tool developed by Melynck and Fineout-Overholt (2008). The Cronbach's alpha of the tool is .90, with a Spearman-Brown r of 0.87. In this study, the EBP Belief Scale yielded a Cronbach alpha of 0.846. The nurses rated the items on a 4-point scale from strongly agree to strongly disagree.

Lastly, the study adopted the Research Utilization Questionnaire (RUQ) further revised by Wallin et al. (2003). The Cronbach's alpha of the tool ranged from 0.71-0.90. In this study, research utilization yielded a Cronbach alpha of 0.783. The respondents rated each item using a 5-point Likert scale from strongly agree to strongly disagree.

Data Gathering Procedures. The researcher obtained ethical approval from the Saint Louis University Research Ethics

committee under protocol number SLU-REC 2022-001 and the institutional review board of the CHAG with protocol number CHAG-IRB06012022. The researcher employed (6) six research assistants in Ghana with quantitative research experience. The research assistants began data collection after approval and endorsement by the head nurses or nurse administrators. Data collection commenced on April 4th, 2022 to June 30th, 2022. Upon receiving informed consent, the respondents filled out the research questionnaires. The respondents were given a day to be able to fill out the questionnaire during their non-duty hours to avoid disruption of daily nursing routines. The research assistants encoded the data with frequent monitoring and instructions from the researcher. The research assistant sent the encoded data on an EXCEL sheet to the researcher via email for data analysis.

Statistical Tool and Treatment. The study utilized descriptive and inferential statistics to analyze the data using the Jamovi Statistical Software. The statistical technique to be employed in the study was as follows: percentages, frequency distribution, mean, standard deviation, Pearson Correlation Coefficient, ANOVA and GLS mediation analysis.

Ethical Considerations. The respondents were informed about the purpose of the study, and informed consent were sought from the respondents. Participation was solely voluntary, and no compensation was given to the participants. The respondents had the right to refuse or withdraw from the study without facing any penalty. The respondents were treated fairly and equally without any judgment. Anonymity and privacy was adhered to throughout the study in which the respondents' identity and any identifiable information were not included in the study report. Only aggregate data was presented in the study report.

Results

The findings of the study as presented in Table 2. suggests that the level of EBP competency among the respondents is low. However, despite the low level of EBP competency the respondents possess a positive belief about the value and confidence towards EBP as presented in Table 3. In terms of research utilization, the respondent's level of research utilization in the clinical setting is low as presented in Table 4.

Table 5 presents the relationship between EBP competency, EBP beliefs, and research utilization. The statistical results showed a moderately significant positive relationship between EBP competency and research utilization ($r = .431, p = .000$), EBP competency and EBP beliefs ($r = .327, p = .000$) and EBP beliefs and research utilization ($r = .306, p = .000$).

In terms of differences, EBP competency and research utilization showed no significant difference when EBP training

Table 2. Level of EBP Competency among Ghanaian Nurses

Domain	Mean (M)	Standard Deviation (SD)	Interpretation
EBP Attitude	2.84	0.491	Moderate Competence
EBP Knowledge	2.07	0.341	Low Competence
EBP Skills	2.08	0.433	Low Competence
EBP Utilization	2.16	0.385	Low Competence
Overall EBP Competency	2.27	0.255	Low Competence

Legend: 4.20-5.00 (Very High Competence), 3.40-4.19 (High Competence), 2.60-3.39 (Moderate Competence), 1.80-2.59 (Low Competence), 1.00-1.79 (Very Low Competence)

Table 3. The Current EBP Beliefs among Ghanaian Nurses

Domain	Mean	Standard Deviation	Interpretation	Qualitative Descriptor
Overall EBP Beliefs	2.58	0.322	Positive Belief	Nurses' beliefs about the value of EBP and their confidence to implement it are strong

Legend: 3.33-4.00 (Positive Belief), 2.50-3.32 (Positive Belief), 1.70-2.49 (Negative Belief), 1.00-1.69 (Negative Belief)

Table 4. The Level of Research Utilization among Ghanaian Nurses

Domain	Mean	Standard Deviation	Interpretation
Attitude towards Research	2.82	0.419	Moderate Research Utilization
Availability and support to implement research findings	2.42	0.523	Low Research Utilization
The use of research findings in daily practice	2.39	0.315	Low Research Utilization
Overall Research Utilization	2.57	0.300	Low Research Utilization

Legend: 4.20-5.00 (Very High Research Utilization), 3.40-4.19 (High Research Utilization), 2.60-3.39 (Moderate Research Utilization), 1.80-2.59 (Low Research Utilization), 1.00-1.79 (Very Low Research Utilization)

Table 5. The Relationship Between EBP Competency, EBP Beliefs, and Research Utilization among Ghanaian Nurses

		EBP Competency	EBP Beliefs	Research Utilization
EBP Competency	Pearson Correlation	1	.327*	.431**
	Sig. (2-tailed)		.000	.000
	N	544	544	544
EBP Beliefs	Pearson Correlation	.327**	1	.306**
	Sig. (2-tailed)	.000		.000
	N	544	544	544
Research Utilization	Pearson Correlation	.431**	.306**	1
	Sig. (2-tailed)	.000	.000	
	N	544	544	544

** Correlation is significant at the 0.01 level (2-tailed).

Table 6. Mediation Effect of EBP Beliefs on EBP Competency and Research Utilization

95% C.I. (a)								
Type	Effect	Estimate	SE	Lower	Upper	β	z	p
Indirect	EBP COM $\Rightarrow$ EBP B $\Rightarrow$ RU	0.0710	0.0178	0.0362	0.106	0.0604	3.99	< .001
Component	EBP COM $\Rightarrow$ EBP B	0.4130	0.0511	0.3128	0.513	0.3274	8.08	< .001
	EBP B $\Rightarrow$ RU	0.1720	0.0375	0.0986	0.245	0.1845	4.59	< .001
Direct	EBP COM $\Rightarrow$ RU	0.4354	0.0472	0.3428	0.528	0.3703	9.22	< .001
Total	EBP COM $\Rightarrow$ RU	0.5064	0.0455	0.4172	0.596	0.4307	11.12	< .001

Note. Confidence intervals computed with method: Standard (Delta method)

attendance is considered. In terms of years of experience, Post-hoc comparison using the Tukey Post-Hoc Test showed that nurses with 1-2 years of experience have a higher level of EBP competency. In terms of clinical unit of assignment, Post hoc comparison using the Tukey Post-Hoc Test indicated that theatre nurses have a higher level of EBP competency when compared to other clinical units. Additionally, in terms of research utilization, post-hoc comparison using the Tukey Post-Hoc Test showed that that emergency nurses have a lower level of research utilization as compared to surgical nurses.

Table 6 shows the mediating role of EBP beliefs on EBP competency and research utilization among Ghanaian nurses. The findings suggests that EBP beliefs partially mediates the relationship between EBP competency and research utilization.

Discussions

The findings of the study showed that Ghanaian nurses had an overall low EBP competency to implement the EBP process. The findings of the study are consistent with Fu et al. (2020), Harper (2017), and Melynck et al. (2017). Fu et al. (2020) study conducted among Chinese nurses noted that their self-assessment of EBP competency was low. Similarly, Melnyk et al. (2017) study conducted among 2,344 USA nurses showed that USA nurses did not believe that they met the required EBP competencies. The low level of EBP competency among Ghanaian nurses can be attributed to several factors. Firstly, Ghanaian nurses in this study lacked exposure to EBP skill-building training and seminars. The findings of this study revealed that 48.2% of nurses had attended no EBP training, and only 3.7% of nurses had attended six or more EBP training during their employment. The results led to a similar conclusion where Aynalem et al. (2021) study provides evidence that only 23% of nurses in Ethiopia received EBP training which also contributed to the low EBP competency among Ethiopian nurses.

In the Ghanaian setting, guidelines and protocols are not updated regularly based on evidence (Atakro et al., 2020).

Atakro et al. (2020) added that Ghanaian nurses with 1-5 years of experience rely on nurses with more clinical years of experience and doctors' orders due to the unclear job description on nurses' expectations towards the use of evidence in practice. Additionally, nurses in Ghana due to the lacked adequate resources to facilitate the enhancement of their EBP competency such as EBP skills-building activities, internet, library, and electronic databases. In addition, Bayuo (2017) mentioned that there is a lack of EBP mentors and champions in the healthcare system to equip nurses with EBP utilization competence and change within the organization to facilitate a culture of EBP.

Despite the low level of EBP competency, nurses possess a positive belief towards EBP. This shows that Ghanaian nurses in this study valued EBP and it's importance in providing quality patient care as EBP is integrated in the Ghanaian nursing curriculum. Consistent with other studies on EBP beliefs (Cruz et al., 2016; Leufer et al., 2021; Stokke et al., 2014) showed a positive belief among nurses strengthens use of research-based knowledge among nurses in the clinical setting.

Low research utilization suggests that nurses' attitude towards research, availability, and support to implement research findings and use of research in daily practice is inadequate. The findings of this study are in accordance with Dagne and Tebeje (2021) and Kousar et al. (2017). Although Ghanaian nurses agreed that research was performed within the community and workplace, they lacked time to read the research, did not have access to research findings within the workplace, and the unit managers did not support research utilization. Moreover, in Ghana, the allocation of time to engage in research activities while on duty is not given to nurses and is perceived to be an activity to be engaged during non-duty hours. Lack of time to read research among nurses and the lack of resources and adequate support were consistent with the findings of previous research studies (Da'seh & Rababa, 2021; Hu et al., 2019; Mahaki et al., 2016; McCleary & Brown, 2003; Melnyk et al., 2012).

The findings of this study have contributed to the understanding of the level and relationship between EBP competency, EBP beliefs, and research utilization among Ghanaian nurses in CHAG hospitals. The strength of this study lies in its large sample size of 544 nurses, which increases the generalizability of the findings among CHAG hospitals in Ghana. However, there are a few limitations to this study. Firstly, the study was conducted within six CHAG hospitals in Ghana and, therefore, cannot be generalized beyond this specific type of organization. The study relied on self-reported measures, which may introduce response bias or social desirability bias, affecting the accuracy of the data collected.

Conclusions and Recommendations

In order to utilize the best research during nursing decision-making, planning patient care, and generally guiding Ghanaian nurses in CHAG hospitals, the findings support that nurses need to improve their EBP competency, strengthen their EBP beliefs and the provision of adequate support and resources by the organization is essential to sustain the utilization of research-based knowledge. It is recommended that nursing administrators integrate the expectations of research utilization and EBP during the clinical lifespan of nurses and provide adequate resources and support to increase the level of research utilization. Policymakers are encouraged to set clear organizational EBP and research utilization goals and standards. In nursing research, it is recommended that future studies utilize qualitative approval to understand how culture influences EBP in the Ghanaian context.

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Let us never consider ourselves finished, nurses. We must be learning all of our lives.

Florence Nightingale, *founder of modern nursing*