Comprehensive Evaluation of Computerized Information Systems in Enhancing Nursing Practice and Clinical Decisions

Evaluación integral de los sistemas de información informatizados en la mejora de la práctica enfermera y las decisiones clínicas

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ABSTRACT

Nursing practice has been revolutionized by the incorporation of computerized health information systems into clinical settings, which have improved workflow efficiency, supported evidence-based decision-making, and improved patient data management. The efficacy in enhancing clinical decision-making and nursing practice requires a thorough assessment. The purpose of the research is to examine how computerized health information systems affect clinical decision-making, patient safety, and nursing workflows while identifying critical elements that affect efficacy in various healthcare settings. A comprehensive survey with an emphasis on system usability, integration into clinical processes, and perceived influence on patient outcomes was administered to 210 registered nurses from different hospital units. To achieve a comprehensive assessment, a mixed-method approach was used, combining qualitative observations and quantitative statistical analysis. It examines how computerized health information systems boost multidisciplinary collaboration, increase documentation accuracy, and assist clinical decision-making in real-time. To investigate the connections between system effectiveness, user experience, and clinical performance, descriptive and inferential statistical methods were used, such as regression analysis and structural equation modeling (SEM). Results show computerized health information systems greatly enhance decision support, clinical workflow effectiveness, and documentation accuracy. It emphasizes how crucial computerized health information systems are to contemporary nursing practice. Maximizing the influence of systems on patient care and decision-making requires improving system design, ensuring training is appropriate, and matching features with clinical requirements.

Keywords: Computerized Health Information Systems (CHIS); Nursing Practice; Evidence-Based Practice; Clinical Decision-Making; Clinical Education; Workflow Efficiency.

RESUMEN

La práctica de la enfermería se ha visto revolucionada por la incorporación de sistemas informáticos de información sanitaria en los entornos clínicos, que han mejorado la eficiencia del flujo de trabajo, apoyado la toma de decisiones basada en la evidencia y mejorado la gestión de los datos de los pacientes. Su eficacia para mejorar la toma de decisiones clínicas y la práctica enfermera requiere una evaluación exhaustiva. El objetivo de la investigación es examinar cómo afectan los sistemas de información sanitaria informatizados a la toma de decisiones clínicas, la seguridad de los pacientes y los flujos de trabajo de enfermería, al tiempo

que se identifican los elementos críticos que afectan a la eficacia en diversos entornos sanitarios. Se realizó una encuesta exhaustiva a 210 enfermeras diplomadas de diferentes unidades hospitalarias, en la que se hizo hincapié en la facilidad de uso del sistema, su integración en los procesos clínicos y la influencia percibida en los resultados de los pacientes. Para lograr una evaluación exhaustiva, se utilizó un método mixto que combinaba observaciones cualitativas y análisis estadísticos cuantitativos. Se examina cómo los sistemas informatizados de información sanitaria impulsan la colaboración multidisciplinar, aumentan la precisión de la documentación y ayudan a la toma de decisiones clínicas en tiempo real. Para investigar las conexiones entre la eficacia del sistema, la experiencia del usuario y el rendimiento clínico, se utilizaron métodos estadísticos descriptivos e inferenciales, como el análisis de regresión y el modelado de ecuaciones estructurales (SEM). Los resultados muestran que los sistemas informatizados de información sanitaria mejoran enormemente el apoyo a la toma de decisiones, la eficacia del flujo de trabajo clínico y la precisión de la documentación. Se destaca lo cruciales que son los sistemas informatizados de información sanitaria para la práctica contemporánea de la enfermería. Para maximizar la influencia de los sistemas en la atención al paciente y la toma de decisiones es preciso mejorar el diseño de los sistemas, garantizar que la formación sea adecuada y adecuar las funciones a las necesidades clínicas.

Palabras clave: Sistemas Informatizados de Información Sanitaria (CHIS); Práctica de Enfermería; Práctica Basada en la Evidencia; Toma de Decisiones Clínicas; Educación Clínica; Eficiencia del Flujo de Trabajo.

INTRODUCTION

In a medical facility is evolving quickly, modern computerized information systems are essential for improving clinical decision support and nursing practice.[1] To improve patient care activities, it is often required to integrate electronic-based technology in several forms, such as mobile health applications, clinical decision support systems (CDSS), telemedicine systems, and electronic health records (EHRs).[2] Instant access to a patient's data via a computerized information system promotes effective communication, lowers medical errors, and helps nurses adopt evidence-based practice. Probably the most significant way that computerized information systems assist nursing is by providing accurate and timely documentation. With a lot of patient data in EHRs, a nurse can find it easier to record vital signs, medication history, treatment plans, facts, etc. [3] Furthermore, clinical decision support systems enable nurses to make educated emergency judgments by delivering real-time alerts, recommendations, and suggestions. In addition to making patient safety better, all of these contribute to compliance with healthcare procedures and regulatory requirements.[4] Multidisciplinary collaboration is made possible by computerized technologies, which facilitate easy communication between different healthcare professionals. Some hospital tasks could be substantially replaced by technologies, like telemedicine and remote monitoring, which allow nurses to interact with patients remotely for treatment, particularly in underserved or rural areas. Predictive modeling and data analytics techniques help to identify patterns, forecast results, and customize treatment regimens. As healthcare becomes more digital the usage of electronic information in nursing continues to increases The implementation of these technologies would lead to better patient outcomes and a more data-driven, efficient healthcare system.[5] Limiting computerized information systems involves considering the potential for technical malfunctions or system outages that could disrupt nursing practice workflow. The unsuccessful adoption of computerized information systems could be largely due to data privacy concerns and users' reluctance to address these concerns into their acceptance and usage. The research investigates how CHIS impacts nurse workflows, CDM, and PS, as well as how critical success variables can differ depending on the entire healthcare system.

By using academic and sociodemographic data to provide a questionnaire to 496 nursing students, the investigation validated the Clinical Decision-Making Nursing Scale (CDMNS) for the Portuguese population.[6] With a worldwide α of 0,851, the confirmatory factorial showed high reliability and high-quality factorial structure modification. The CDMNS-PT© is a valid and reliable tool with great potential for application in clinical practice and future research.

An investigation with 205 nurses found a high correlation between clinical decision-making abilities and critical thinking and the quality of nursing transfer.[7] The research found a high correlation between these skills and the quality of nurse transfer. Higher education levels are necessary for nurses to enhance critical thinking and clinical decision-making skills, according to the research, which also indicated education level had the most impact on these abilities.

The present inquiry examined the relationship between clinical decision-making in the nursing profession and core self-evaluation (CSE).[8] The research involved 584 nurses and standardized instruments. The findings indicated a favorable correlation between CSE and clinical decision-making, with locus of control, self-efficacy,

and self-esteem all being important factors. While nurses with low CSE are less resourceful and risk-averse, those with high CSE have good self-perceptions and confidence.

The present research evaluated nursing students' attitudes toward nursing diagnoses and clinical decision-making skills in two Turkish nursing departments.[9] Women made up 77,1 % of the 257 participating students. The findings indicate that nurses' opinions on clinical decision-making are evolving favorable opinions about diagnosis. The result found students' nursing diagnoses favorably and clinical decision-making can be influenced by nursing models in the classroom.

The investigation examines the factors that influences nurses' decisions missed care in pediatric acute hospital care.[10] Four topics were identified through a qualitative investigation employing semi-structured interviews: the role of informal caregivers, hospital logistics, nurses' value system, and priority procedures. The findings have significance for nurse management and offer managers guidance on care planning and missed care in the pediatric clinical context.

Hypothesis Framework

The usability (US) of CHIS enhances nursing workflow efficiency (WE), leading to patient safety (PS) and better clinical decision-making (CDM). Efficient workflows allow timely interventions, reducing errors and thus enhancing the quality of care. The indirect impact of usability on patient safety and decision-making comes through streamlined workflows shown in figure 1.
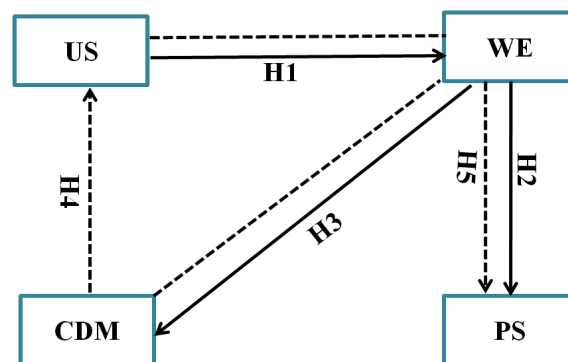

Figure 1. A conceptual framework for hypothesis variables

H1: The usability (US) of computerized health information systems positively influences nursing workflow efficiency (WE)

US is defined as the extent to which nurses can easily use CHIS incorporated into work in day-to-day functioning efficiently with satisfaction. WE is described as performing nursing processes with minimum errors and delays and without any redundancy. The proposition holds an effective CHIS enhances US, leading to a more efficient and streamlined nursing workflow.

H2: Nursing workflow efficiency (WE) positively influences patient safety (PS)

PS involves the prevention of errors and adverse effects associated with patient care. Smooth nursing WE the timely and appropriate execution of activities thereby minimizing delays, miscommunication, and errors. The presented hypothesis states the nursing workflow is well handled, the nurse will prevent mistakes and maintain PS.

H3: Nursing workflow efficiency (WE) positively influences clinical decision-making (CDM)

CDM is the description of how nurses and healthcare workers assess patient conditions, interpret data, and choose appropriate interventions. The hypothesis states better nursing WE makes data easy to access, reduces cognitive overload, and improves decision quality.

H4: The usability (US) of computerized health information systems positively influences clinical decision-making (CDM), mediated by nursing workflow efficiency (WE)

The hypothesis speculates the US is potentially associated with WE, which impacts CDM. An easy-to-use computerized health information system (CHIS) enables the nurse to complete assignments with greater efficiency, thus freeing time for more appropriate critical thought and decision-making rather than spending on inefficient systems.

H5: The usability (US) of computerized health information systems positively influences patient safety (PS), mediated by nursing workflow efficiency (WE)

The hypothesis provides evidence US in CHIS can enhance the WE of nurses, eventually leading to improved

patient safety. A well-designed system prevents documentation errors, delays, and inefficiencies, contributing to a decrease in risk while enhancing the overall quality of PS.

METHOD

The approach begins with a combination of techniques uses both quantitative and qualitative methods to evaluate workflow performance and system usability. Standardized instruments are used to collect data from registered nurses in different units of hospitals. The data are subjected to descriptive statistics, regression analysis, and SEM in evaluating the effectiveness of CHIS in clinical settings.

Research Design

The research adopted a mixed-method research design whereby both quantitative and qualitative approaches were intermixed to enhance the evaluation of computerized health information systems in nursing. The qualitative data investigated nurses' perspectives, experiences, and difficulties with CHIS implementation, while the quantitative data examined the statistical relationship between system usability, clinical workflow integration, and patient outcomes.

Participants and Sampling

A systematic survey was carried out with registered nurses (n=210) working in different hospital units (e.g., emergency, intensive care, general wards, and special departments). A random or stratified sampling method (depending on the research design) was used for sample selection, providing a good representation of different nursing professionals in contact with CHIS in a variety of clinical environments.

Classification and Definitions of Research Variables

In the investigation, usability and workflow efficiency act as predictors (independent variables), while patient safety and clinical decision-making are the outcomes (dependent variables).

Independent Variables
- US: It refers to how easy, efficient, and user-friendly the computerized health information system (CHIS) is for nurses to navigate and perform clinical tasks effectively.
- WE: This represents how well CHIS streamlines nursing processes, reduces task completion time, and enhances productivity without compromising care quality.

Dependent Variables
- PS: It refers to how effectively CHIS prevents medical errors, ensures accurate medication administration, and enhances overall patient care quality.
- CDM: It indicates how well CHIS supports nurses in making evidence-based, timely, and accurate clinical decisions through real-time data access and alerts.

Survey Design and Data Collection

The survey design aimed at collecting data on major variables, such as US, WE, PS, and CDM. It was designed using structured questionnaires from registered nurses for data collection, as shown in table 1.

Table 1. Sample Questionnaire Items for Research Variables	
Variables	**Questions**
US	How easy is it for you to navigate and use the computerized health information system in your daily tasks?
WE	How efficiently are you able to complete your nursing tasks with the help of the computerized health information system?
PS	To what extent do you believe using the computerized health information system helps in preventing medical errors?
CDM	How effectively does the computerized health information system support you in making clinical decisions?

Data Analysis

The assessment uses both descriptive and inferential statistical approaches to ascertain the efficiencies of CHIS. The descriptive statistics generalizes the results with mean ratings, frequencies, and standard deviations related to usability, workflow efficiency, and patient outcomes. The regression analysis determines how far the efficiency and satisfaction of CHIS impact workflow changes and decision-making. SEM contemplated the correlation of usability with documentation compliance and patient safety.

RESULTS

The findings validate CHIS enhances US, WE, CDM, and PS in nursing practice. Confirmatory Factor Analysis (CFA) validated the measurement model to ensure reliability, while regression analysis identified the robust effect of usability on workflow and decision-making. The findings highlight the necessity of optimal CHIS design and integration to improve nursing efficiency and patient care outcomes.

Estimation of the Measurement model

The measuring model's validity was established using the CFA, and the observed variables accurately mirrored the constructs (US WE, CDM, and PS). Factor loading (FL), goodness-of-fit indices, and reliability estimates validated the suitability of the model. The results indicated excellent construct validity and the factors identified well-measured CHIS effectiveness. FL, composite reliability (CR), α, and AVE are included in the given table 2 for the fundamental research constructs that measure validity and reliability.

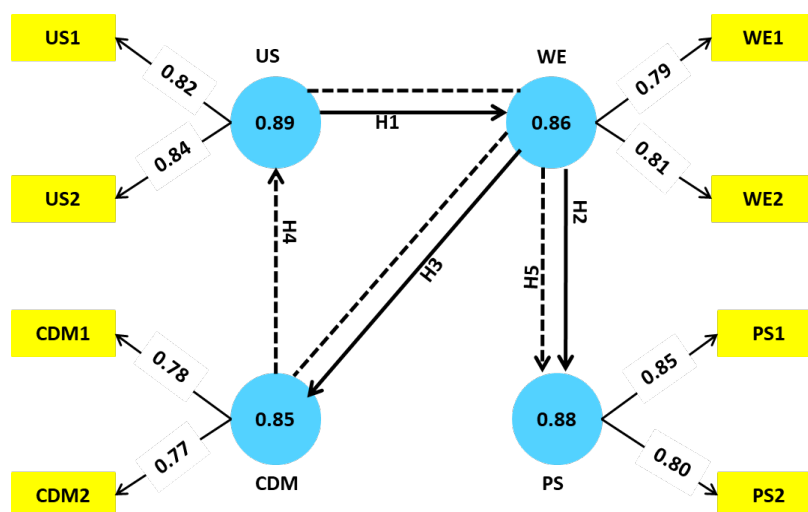| Table 2. Measurement Model for CHIS					
Variables	**Items**	**FL**	**CR**	**α**	**AVE**
US	US1	0,82	0,91	0,89	0,76
	US2	0,84			
WE	WE1	0,79	0,88	0,86	0,70
	WE2	0,81			
PS	PS1	0,85	0,90	0,88	0,75
	PS2	0,80			
CDM	CD1	0,78	0,87	0,85	0,71
	CD2	0,77			

Figure 2. CFA for measurement model validity and reliability

The measurement model has an extremely dependable and valid construct, according to the constructs of the research. Figure 2 illustrates that the FL are all greater than 0,75, indicating that each item loads highly on its factor. Cronbach's alpha (α), which has a value of greater than 0,80, shows strong reliability, which implies appropriate construct validity since the average variance extracted (AVE) is higher than 0,70. Composite reliability has a value surpassing 0,85, which suggests internal consistency. These results confirm the impacts of CHIS on US, WE, PS, and CDM in nursing practice are well captured by the measuring model.

Descriptive Statistical analysis

Descriptive statistic measures to provide a clear view of data central tendency, variability, and overall distribution, allowing a better understanding and presentation of the data characteristics. Equation (1) shows that descriptive statistics aids in understanding variation among samples by quantifying the variability or spread of information points across the mean.

$$T = \sqrt{\frac{\sum |w - \bar{w}|^2}{m-1}} \qquad (1)$$

To calculate sample standard deviation T where w stands for individual data points and w¯ represents the mean of the sample. It calculates the square root of variance, that is, average squared deviations from the mean with degrees of freedom m-1 taken into consideration.

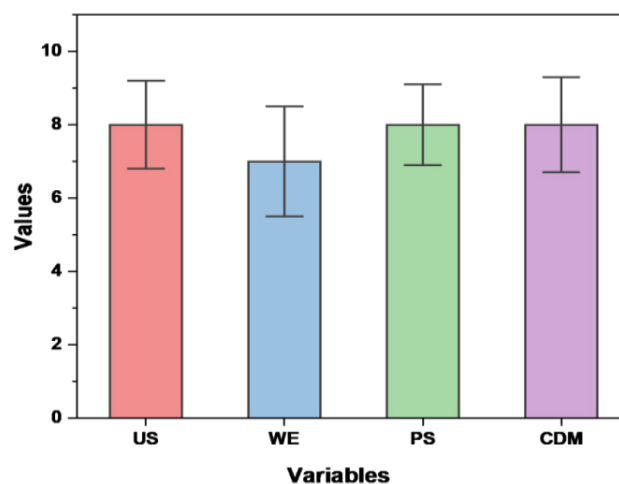| Table 3. Descriptive Statistics for Research Variables					
Variables	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**
US	7,8	8,0	1,2	4	6
WE	7,4	7,0	1,5	3	9
PS	8,0	8,0	1,1	5	7
CDM	7,9	8,0	1,3	4	8

Figure 3. Descriptive statistics analysis for research variables with error bars

The mean, median, standard deviation, minimum, and maximum for the most significant study variables are shown in table 3 and figure 3. US (M = 7,8, SD = 1,2) and PS (M = 8,0, SD = 1,1) had the highest ratings, whereas Nursing WE (M = 7,4, SD = 1,5) and (M = 7,9, SD = 1,3) had the most variability. The findings reflect positive attitudes towards CHIS to enhance clinical workflows and decision-making.

Regression Analysis

Simple linear regression is a widely used statistical technique to examine the relationship between two variables: the dependent variable Y (such as nursing workflow efficiency or patient safety) and the independent variable X (such as CHIS usability). The following equation (2) for basic linear regression:

$$Y = \beta_0 + \beta_1 X + \varepsilon \qquad (2)$$

The dependent variable is denoted by Y, the independent variable by X, the intercept by β_0, the slope by β_1, and the error term by ε. The model helps assess how CHIS usability influences nursing practices and patient outcomes.

Table 4. Regression Estimates for CHIS Effectiveness				
Variables	**Standard Error**	**Coefficient (ß)**	**t-value**	**p-value**
US → WE	0,08	0,45	5,63	<0,001
WE → PS	0,10	0,52	5,20	<0,001
WE → CDM	0,09	0,47	5,22	<0,001
US → CDM→WE	0,07	0,31	4,43	<0,001
US→ WE → PS	0,08	0,40	5,00	<0,001

Table 4 reports standardized regression coefficients (ß) describing associations between US, WE, CDM, and PS in CHIS. The US strongly predicts WE (ß = 0,45, p < 0,001) and PS (ß = 0,40, p < 0,001), demonstrating that

well-designed systems boost output and lower errors. WE is crucial for improving the quality of care since it significantly affects CDM (ß = 0,47, p < 0,001) and PS (ß = 0,52, p < 0,001). CDM is positively impacted by US as well (ß = 0,31, p < 0,001), suggesting better system design enhances nurses' capacity to make decisions. These findings highlight how crucial it is to optimize CHIS use to enhance PS, WE, and CDM.

Path Analysis

A statistical method for examining the direct and indirect interactions between the variables in a proposed model is path analysis. It focuses on how independent factors, especially mediation effects, affect dependent variables. The relevance and strength of these interactions are measured by ß.

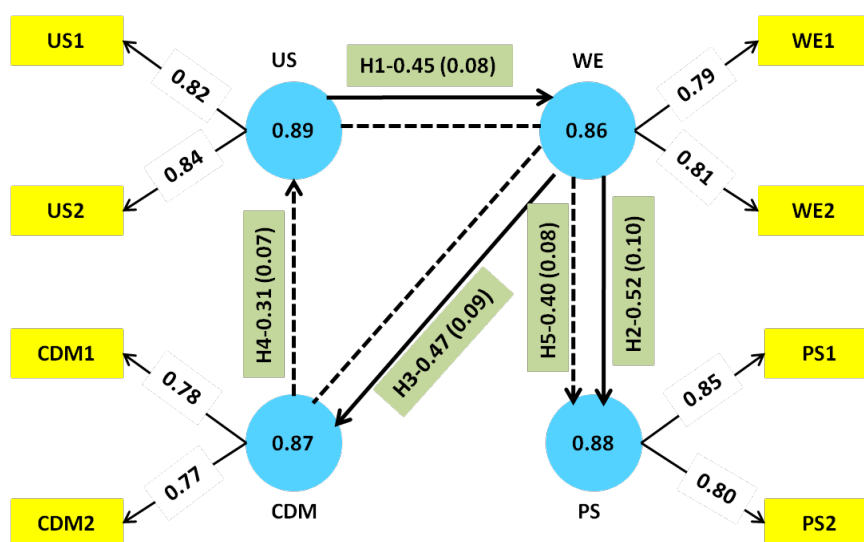| Table 5. Standardized Path Coefficients for CHIS Evaluation							
Hypothesis	Pathways	ß	SE	CI [Lower, Upper]	t-value	p-value	Accepted / Not Accepted
H1	US → WE	0,45	0,08	[0,30, 0,60]	5,63	<0,001	Accepted
H2	WE → PS	0,52	0,10	[0,32, 0,72]	5,20	<0,001	Accepted
H3	WE → CDM	0,47	0,09	[0,29, 0,65]	5,22	<0,001	Accepted
H4	US → CDM→WE	0,31	0,07	[0,17, 0,45]	4,43	<0,001	Accepted
H5	US→WE →PS	0,40	0,08	[0,24, 0,56]	5,00	<0,001	Accepted

Figure 4. Path analysis model for CHIS standardized regression estimates

The results of path studies that examined how US, WE, CDM, and PS interact with CHIS are shown in table 5 and figure 4. WE (ß = 0,45, p < 0,001), CDM (ß = 0,47, p < 0,001), and PS (ß = 0,52, p < 0,001) all show a discernible improvement in the US. The US has a direct effect on PS (ß = 0,40, p < 0,001) and CDM (ß = 0,31, p < 0,001). The results validate the significance of the US in raising PS and productivity. CDM and productivity may be significantly increased by strengthening CHIS's interaction with the US.

DISCUSSION

The CFA has provided an avenue for the reliability and validity of the measurement model encapsulating usability, effective workflow, clinical decision making, and patient safety. Some descriptive analysis shows nurses appreciated the utility of CHIS; however, there were varied responses suggesting differences in system usability under different clinical settings. For a consistent user experience, continuous development is required. Workflow effectiveness is the biggest predictor of the association between usability and clinical success, according to regression analysis. This suggests that well-designed CHIS facilitates decision-making, lowers mistakes, and offers a more efficient workflow. Path analysis validates these relationships and it shows how well-designed usability can lead to improved workflow, decision-making, and patient safety. These findings stress the need to optimize CHIS capability, provide training, and ensure its seamless integration into care delivery.

CONCLUSIONS

Computerized health information systems enhance nursing practice through increased workflow productivity, accurate documentation, and clinical decision support. CHIS enables access to real-time data, minimizes medical

mistakes, and enhances interdisciplinary communication. These results highlight the significance of maximizing CHIS design and integration. Providing proper training and system flexibility is instrumental in achieving peak effectiveness. The research points out the pivotal position played by computerized health information systems in contemporary nursing practice. Improving system design, adequate training, and synchronizing system functionalities with clinical demands are critical for achieving the greatest effect on patient care and decision-making. Limitations of the current research include small sample size, response bias, and differing degrees of CHIS adoption in hospital settings, which can impact generalizability. Future studies will consider the influence of computerized health information systems on long-term nursing performance and patient outcomes across various healthcare contexts. Future studies examine user flexibility and training efficacy to improve system performance and usability.

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CONFLICT OF INTEREST
The authors declare that there is no conflict of interest.

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Methodology: Debajani Nayak, Sujayaraj Samuel Jayakumar, Sonia Mehta.
Software: Debajani Nayak, Sujayaraj Samuel Jayakumar, Sonia Mehta.
Drafting - original draft: Debajani Nayak, Sujayaraj Samuel Jayakumar, Sonia Mehta.
Writing - proofreading and editing: Debajani Nayak, Sujayaraj Samuel Jayakumar, Sonia Mehta.