Centralized Pump Monitoring System: Utility Perception on Workflows by Nurses in a Tertiary Hospital

Naruemol Chindamorragot, Orawan Suitthimeathegorn, Amit Garg

Submitted to: Asian/Pacific Island Nursing Journal
on: May 03, 2024

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Abstract

Nurses play a key role in providing in-hospital care to patients. Worldwide, there has been a shortage of nursing staff, putting enormous strain on the existing nursing workforce physically and mentally. A vicious cycle of demanding workplaces exacerbated by perennial shortages leads to attrition and high staff turnover. A centralized, automated infusion pump monitoring system optimizes and augments nurses' performance in the hospital by cutting down on patients' bedside visits for every matter, whether significant or insignificant. By filtering out the noise effectively, the nurses can focus on improving patient outcomes-led interventions and enhancing quality care.

(JMIR Preprints 03/05/2024:60116)
DOI: https://doi.org/10.2196/preprints.60116

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Abstract

Nurses play a key role in providing in-hospital care to patients. Worldwide, there has been a shortage of nursing staff, putting enormous strain on the existing nursing workforce physically and mentally. A vicious cycle of demanding workplaces exacerbated by perennial shortages leads to attrition and high staff turnover. A centralized, automated infusion pump monitoring system optimizes and augments nurses' performance in the hospital by cutting down on patients' bedside visits for every matter, whether significant or insignificant. This viewpoint intends to highlight that by filtering out the noise effectively, the nurses can focus on improving patient outcomes-led interventions and enhancing quality care.

Keywords: Infusion Management, Nurse Efficiency, Pump Monitoring System, Nurse Attrition

Introduction

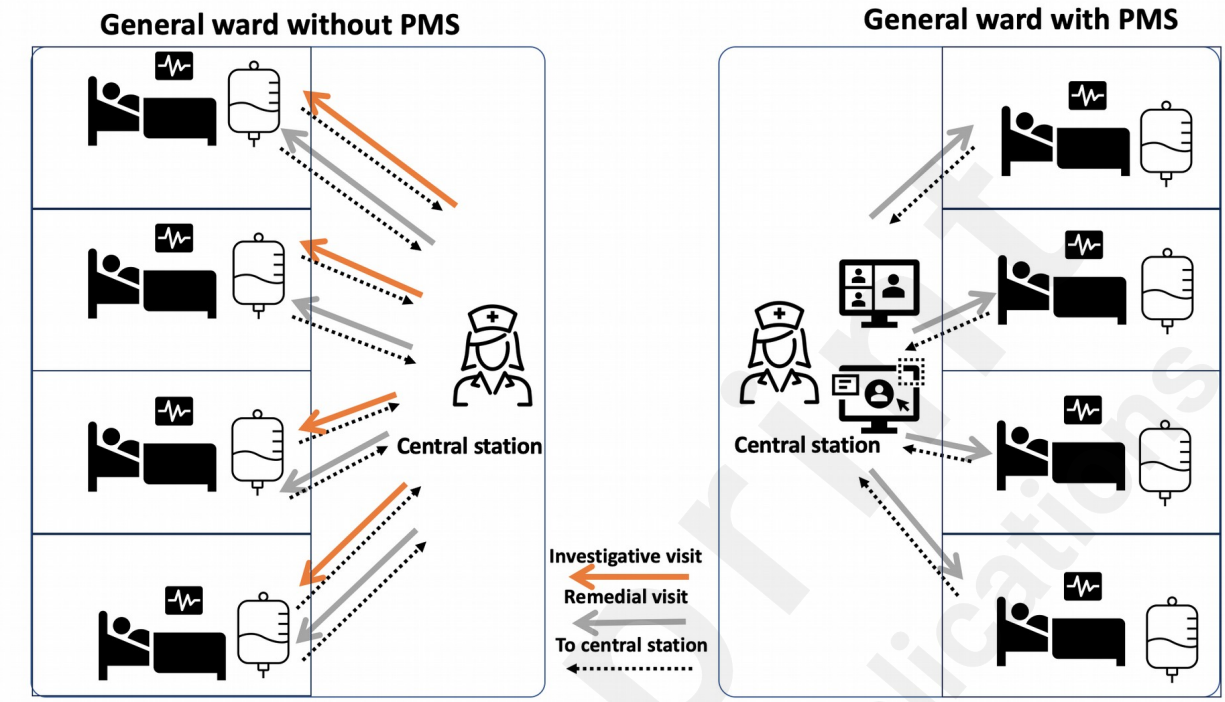
A centralized, automated infusion pump monitoring system (PMS) is a dynamic mechanism that integrates multiple infusion pumps from a central location, such as a nurse station. By generating alerts, infusion pumps with dose error-reduction systems (DERS) drug libraries warn nursing staff about potential prescribing, calculation, and programming errors. They are equipped with hard limits (unable to bypass and prevent the start of the infusion) or soft limits (warns of outside range parameters but permits users to start the infusion). Drug libraries can be customized according to institutional needs and are classified into care areas, configuration for patient groups, care-specific areas, or configured according to body weight. The system can help improve patient safety, comfort, and outcomes by ensuring accurate and timely administration of treatments and preventing treatment-related adverse events (AE) [1].

Our editorial focuses on nursing challenges in general wards, PMS, and the key outcomes from a survey conducted at a multispecialty hospital in Thailand.

Nursing challenges in General Ward and PMS utility

In a general ward, patients are generally conscious, and the alarm originating from infusion pumps may disturb patients, create unwanted anxiety, and incur additional nurse visits to the patient's bedside [2,3]. Responding to each alert and distress call warrants nurse visits for visual checks, which is time-consuming, physically demanding, and enhances cognitive stress [2,3]. This was also found in the survey, which is discussed later. Nursing as a profession is beset with a stressful environment [4,5,6,7]. The exhaustion is both physical and mental. Work exhaustion compounded by the stressful job of handling emergencies and responding to distress calls and alarms for multiple patients in a general ward could take a heavy toll on the state of the personal health of nurses. We have demonstrated the state of affairs in a hospital's general ward, whereby a nurse has to manage multiple patients. If the process is manual, it leads to physical exertion, stress, and exhaustion (*Figure 1*). As illustrated in the left-hand side of the figure, a nurse makes an investigative visit to the patient's bed upon registering distress calls (orange arrow) and then returns to her central station (black arrow). After finding a solution, she makes another visit to the patient's bed and administers remedial measures (grey arrow). However, if a ward is equipped with PMS, as illustrated on the right side of the figure, the nurse can identify the problem on the centralized monitor (for instance, blockade) and solve the issue in a single visit. Therefore, the additional steps for each patient call are eliminated, resulting in less physical effort and exhaustion. Staff burnout impacts organizational performance, patient safety, and health outcomes if appropriate interventions are not undertaken.

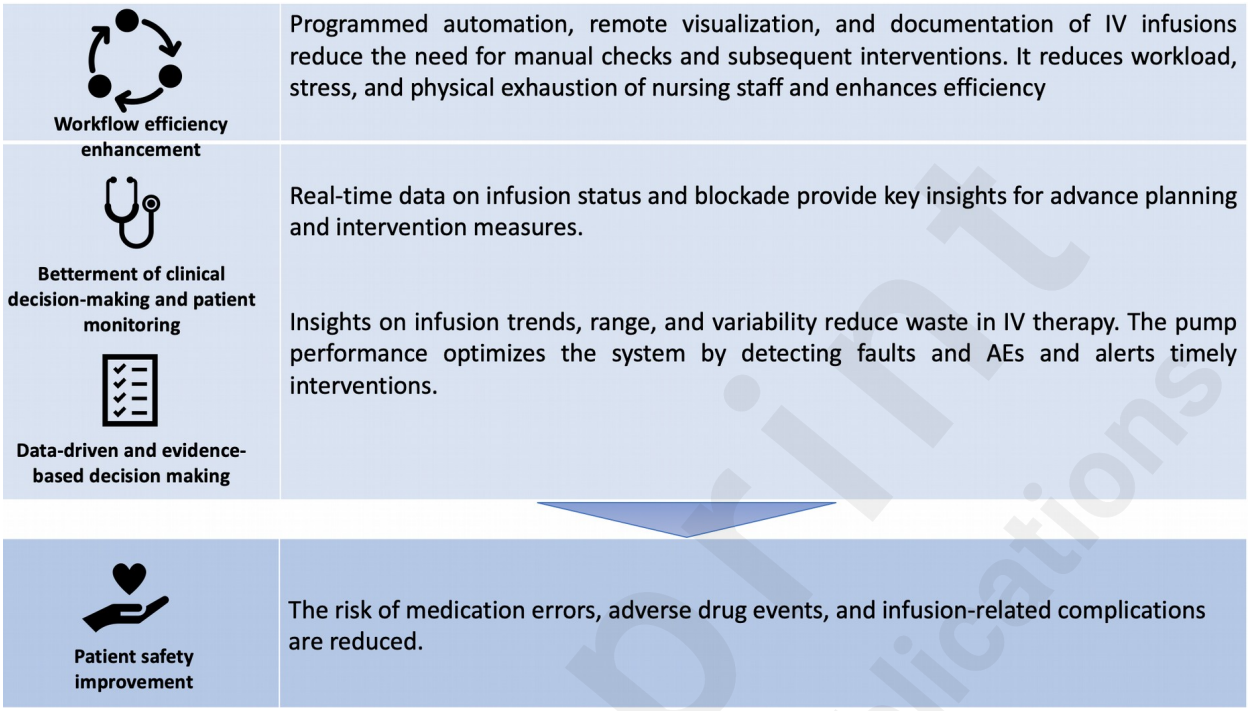
Figure 1. In general wards, the use of PMS with an infusion system reduces nurse's movement and improves workflow efficiency in comparison to without PMS.



Impact of PMS on nurse's workflow in hospitals

PMS is critical in reducing physical movements with the centralized display of infusion status on the monitor. Regardless of the clinical settings, prevention and detection of infusion errors, such as incorrect doses or infusion data, PMS prevents undetected infusion errors and facilitates care coordination and collaboration with other healthcare professionals by sharing IV infusion data and alerts through the network and the health information systems [8]. Several benefits have been attributed to the PMS, benefitting all the stakeholders – patients, nurses, and care providers in the healthcare ecosystem, as shown in Figure *2*.

Figure 2. PMS benefits to the stakeholders in care delivery. Workflow efficiency improvement, better decision-making, and closer patient monitoring result in greater patient safety standards.



Key Outcomes of the Nurses Survey in General Ward

We present the survey conducted in our Bangkok Hospital Sanamchan (210 beds) situated in Mueang District, Nakhon Pathom Province. A cross-sectional survey of the 91 nurses working in the general ward was conducted in October 2023, and they were asked to report their feedback on a seven-Likert scale. The nurses were manually explained the presented questions and submitted their responses in complete privacy on a paper-based system. The key objectives of the survey were:-

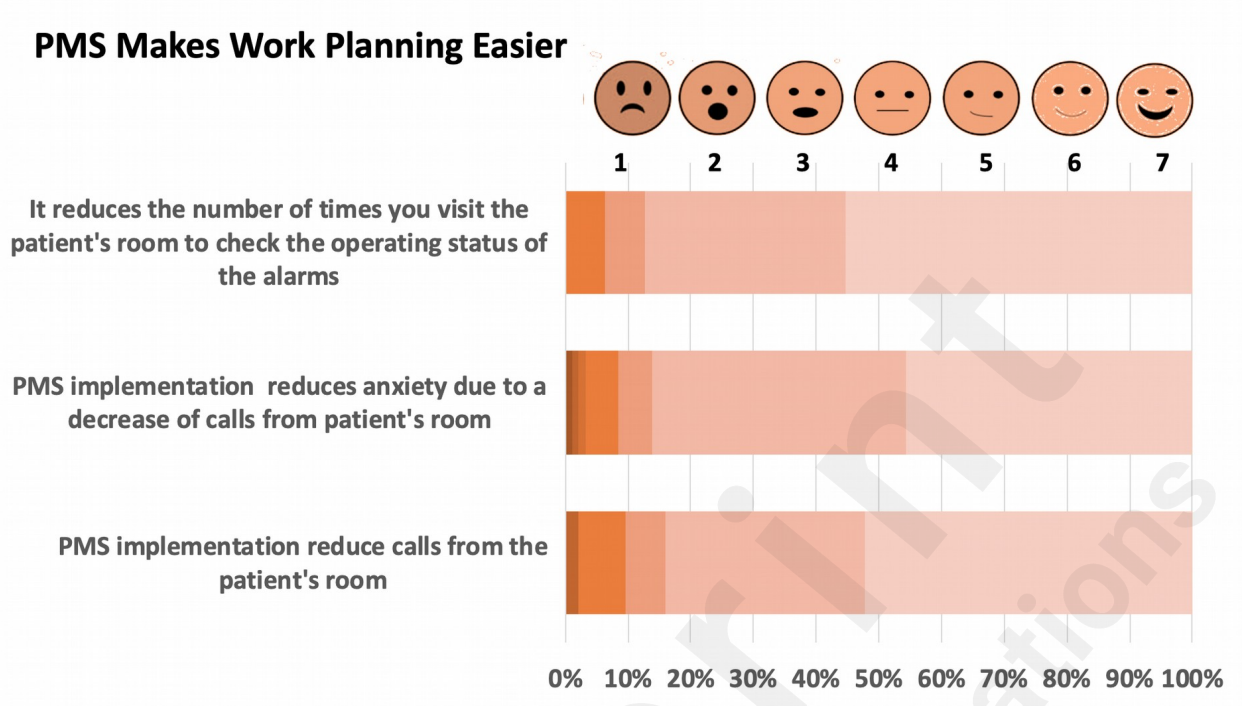
- To evaluate the work efficiency of nursing staff after implementation of a PMS. The efficiency parameters included reducing the frequency of entering patients' rooms to check pump status, decreasing the number of nurse calls, and other related factors.
- To examine the potential impact of PMS on nursing workflow, work planning, and patient recovery.

The response scheme was indicated on these variables: 1= Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neither agree OR disagree, 5= Somewhat agree, 6 = Agree, 7 = Strongly agree. The responses were compiled in Excel, and inferential analysis was applied to the data. The results were interpreted as central tendency analysis of 'mean' and plotted in intuitive graphical form. The survey questionnaire is available.

Impact of PMS on the work planning of nurses

More than 80% of the respondents stated that PMS reduces the number of visits to the patient’s room to check on the patient's operating status, and they felt anxiety reduced due to fewer calls from the patient’s room. Almost a similar level of response was received on the decrease in the number of calls from patient’s rooms due to PMS adoption (*Figure 3*).

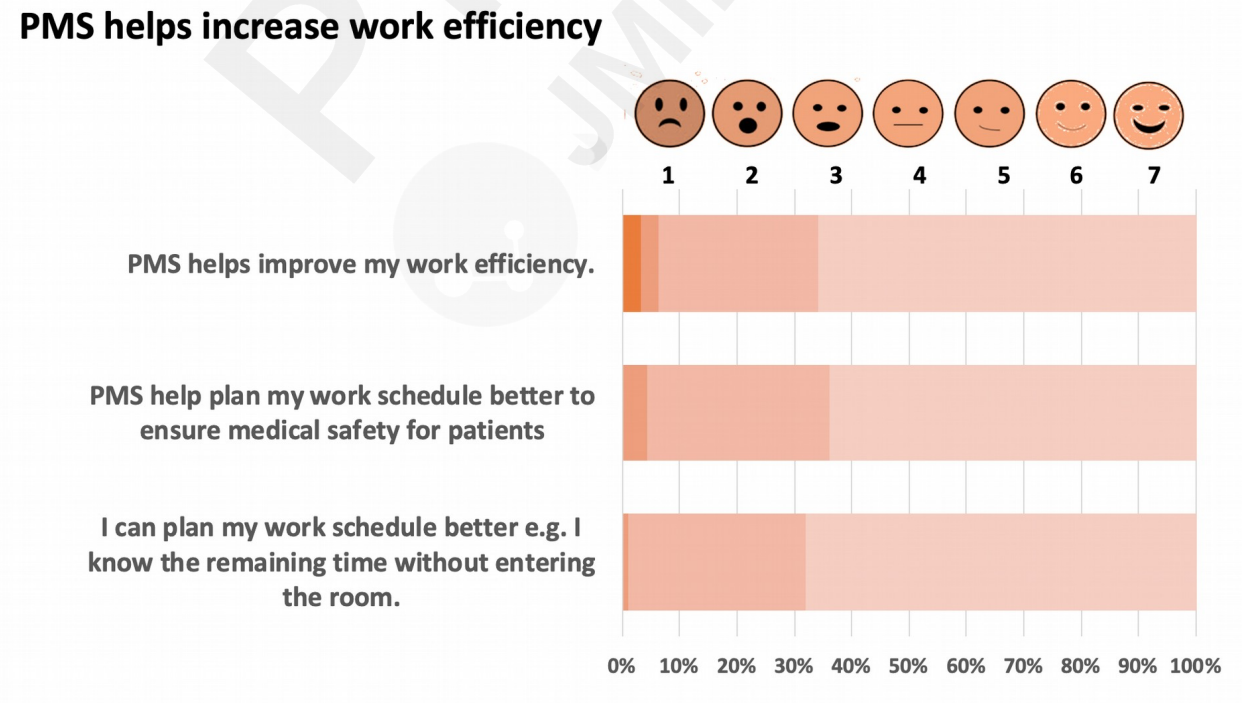
Figure 3. PMS impact on work planning and efficiency



Impact of PMS on Work Efficiency

More than 95% of the respondents reported that PMS helps improve work efficiency, helps in work schedule planning to ensure patient safety, and saves time (*Figure 4*).

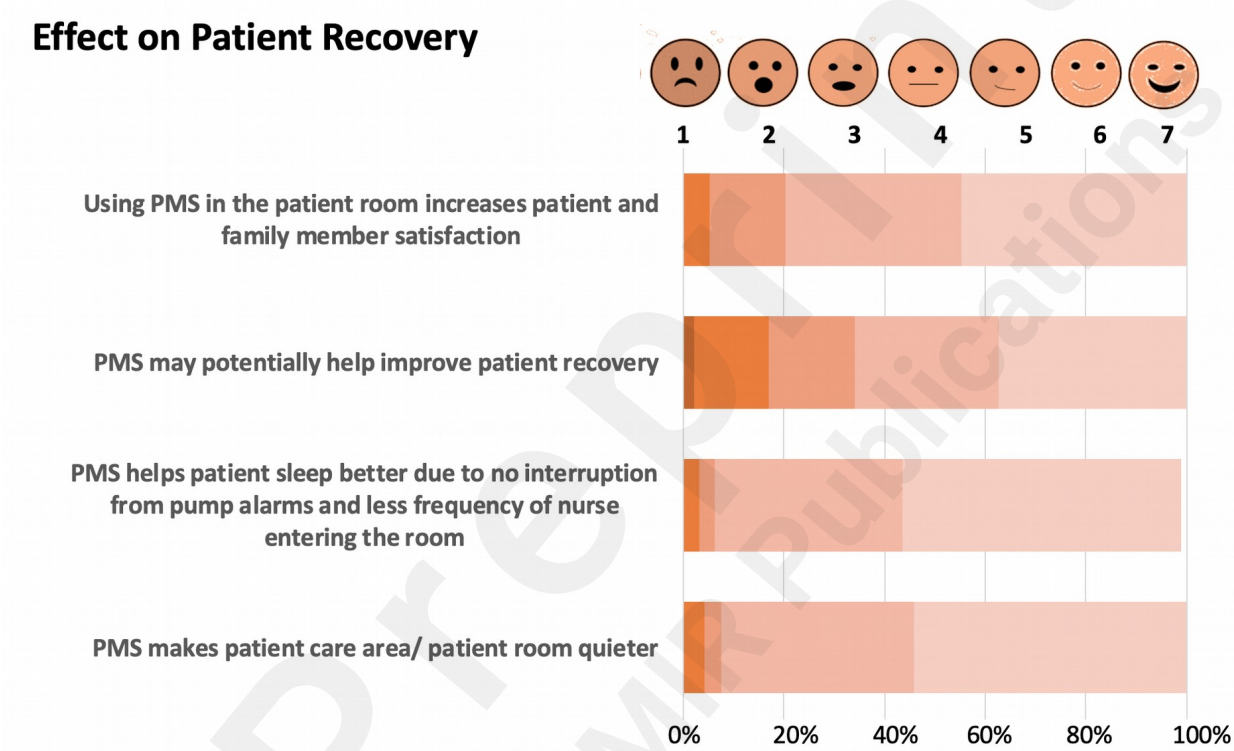
Figure 4. Work efficiency with PMS integration in the workflow



Impact of PMS integration on patient recovery

Almost 95% of respondents stated that usage of PMS in a patient's room increases patient and family member satisfaction. Meanwhile, 80% of respondents indicated that PMS may help improve patient recovery. More than 95% of respondents mentioned that patients sleep better due to the lack of disruption and fewer nursing staff visits to the room, making the patient care area quieter (*Figure 5*).

Figure 5. Effect of PMS on patient recovery



The findings outline the two broad-based attributes: PMS benefits and its impact on improving patient outcomes. Figure 3 and Figure 4 show that the workflow planning and efficiency are enhanced with PMS, while Figure 5 shows that patient recovery is possibly boosted due to better rest, fewer sleep disturbances, and lesser care delivery-generated stress.

We would like to highlight that large-scale studies in diverse settings are needed to reproduce and replicate these results we have obtained. These outcomes must be viewed from an indicative perspective and may not be representative phenomena with PMS across all healthcare systems.

Critical implications for patient care

The survey findings point to the issue of nurse distraction and continuous disengagement from the involved tasks when any patient distress signals are heard in a general ward

setting. The resultant anxiety and immediate dash to check on the patient's status has two significant adverse impacts – the mental and physical health of the nurses. The general ward is relatively spread out, and the diversity of patients' mix makes nursing care more strenuous. While there are many established benefits of PMS, we would like to draw our implications from the outcomes of this survey as a more pragmatic approach.

The most apparent benefits of PMS for the nursing staff are the ability and flexibility to plan work schedules more organized and efficiently, reduce multiple movements, and discharge patient care duties with less exhaustion and greater focus [8]. Also, the PMS ensures no unnecessary patient distress, sleep disturbances, and bedside environment stability. The resultant effect on patient recovery and outcomes is compounded due to more efficient nursing care in the hospital [9,10].

PMS application requires an integrated, multimodal approach to render efficiencies and deliver benefits at scale. This include infrastructure, training, network, interoperability of the health information system, and monitoring with a collective approach to align with the goals of enhancing the quality of patient care.

Future trends

Technology and data-driven innovation have resulted in the development of PMS models to advance patient care faster. Also, with PMS integration into electronic health records (EHR), more and more real-world data is being generated, resulting in more advanced PMS [11,12].

Interconnected, interoperational eco-system: The wireless connectivity of PMS, image recognition - barcode medication administration (BCMA) & radio-frequency identification (RFID), computerized prescriber order entry (CPOE), and integration into EHR seem the next wave forward. Each of these technologies exists and is being utilized in hospitals, but these may be operated in "silos" and not as integrated, interconnected ecosystems. It is envisaged that these technologies when working in unison as a cohesive force, can provide auto-programming and auto-documentation, clinical decision support, clinical surveillance, and an alert mechanism that highlights critical situations demanding immediate intervention and communicates to the best healthcare professional who is best positioned to solve the problem.

Conclusion

PMS enhances the nursing staff's functional and physical capabilities during their workflows, enabling better performance within the hospital environment. A more systematic approach and reduced exhaustion contribute to fewer nursing care errors. As a result, the quality of patient care improves, leading to better care outcomes. Eventually, all the stakeholders in the healthcare ecosystem – patients, clinicians, nursing staff, healthcare system, and society benefit at different levels.

Compliance with Ethical Standards

Author Contributions

All the authors contributed equally to conceptualizing, formal analysis, project administration, writing review, and editing. Naruemol Chindamorragot led the hospital survey and analysis at Bangkok Hospital Sanamchan.

Funding: The authors received no specific funding for this work.

Conflicts of interest: The corresponding author OS and co-author AG are employees of Terumo Asia Holdings Pte Ltd, Singapore. NC has none declared.

Data availability statement: The survey data can be made available at a reasonable request by the corresponding author.

Acknowledgments: The medical writing support for the manuscript was provided by Dr. Suchitra Kataria from Mélange Communications Pte Ltd, Singapore.

Multimedia Appendix 1: PMS questionnaire Bangkok Sanamchan

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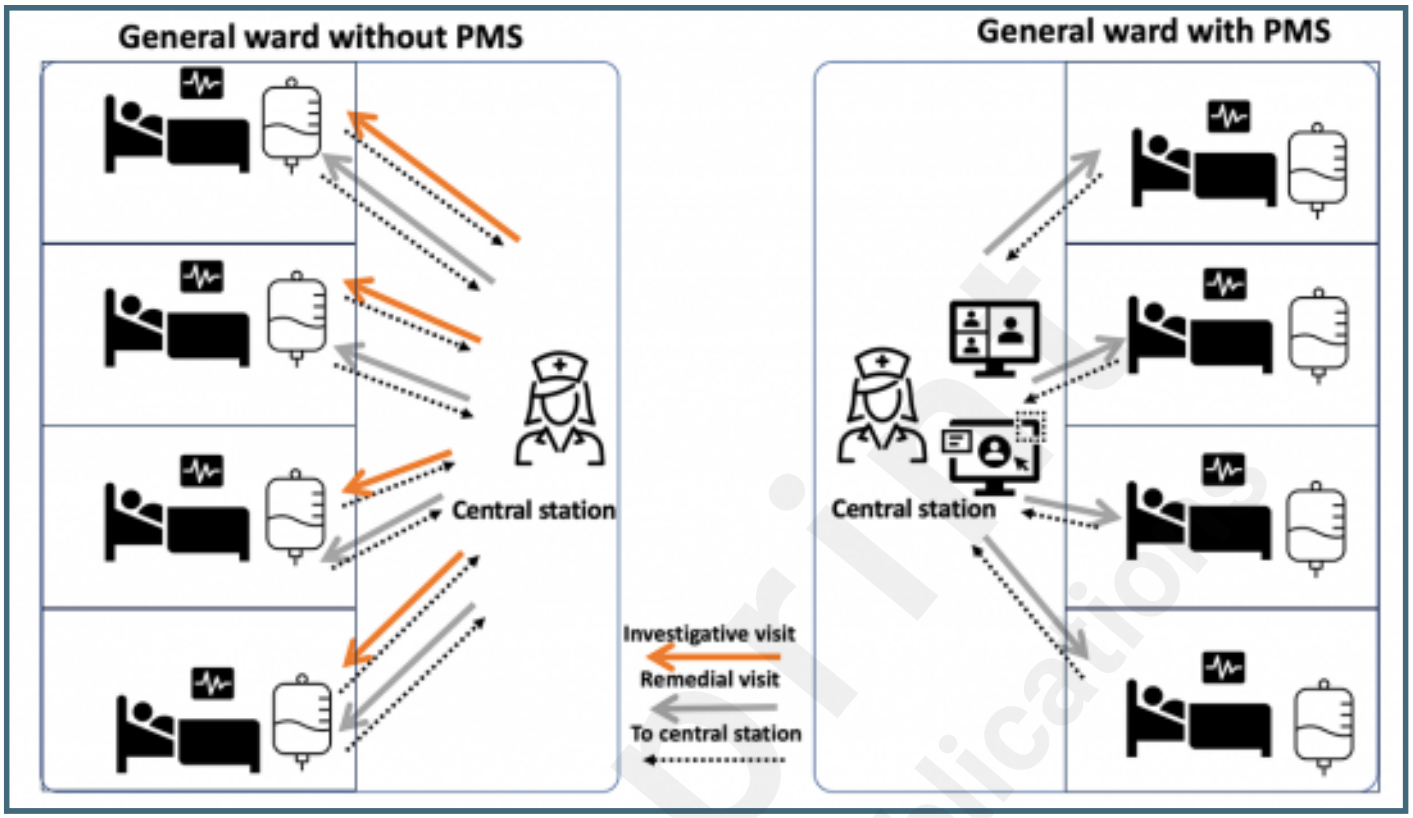
Supplementary Files

Figures

In general wards, the use of PMS with an infusion system reduces nurse’s movement and improves workflow efficiency in comparison to without PMS.



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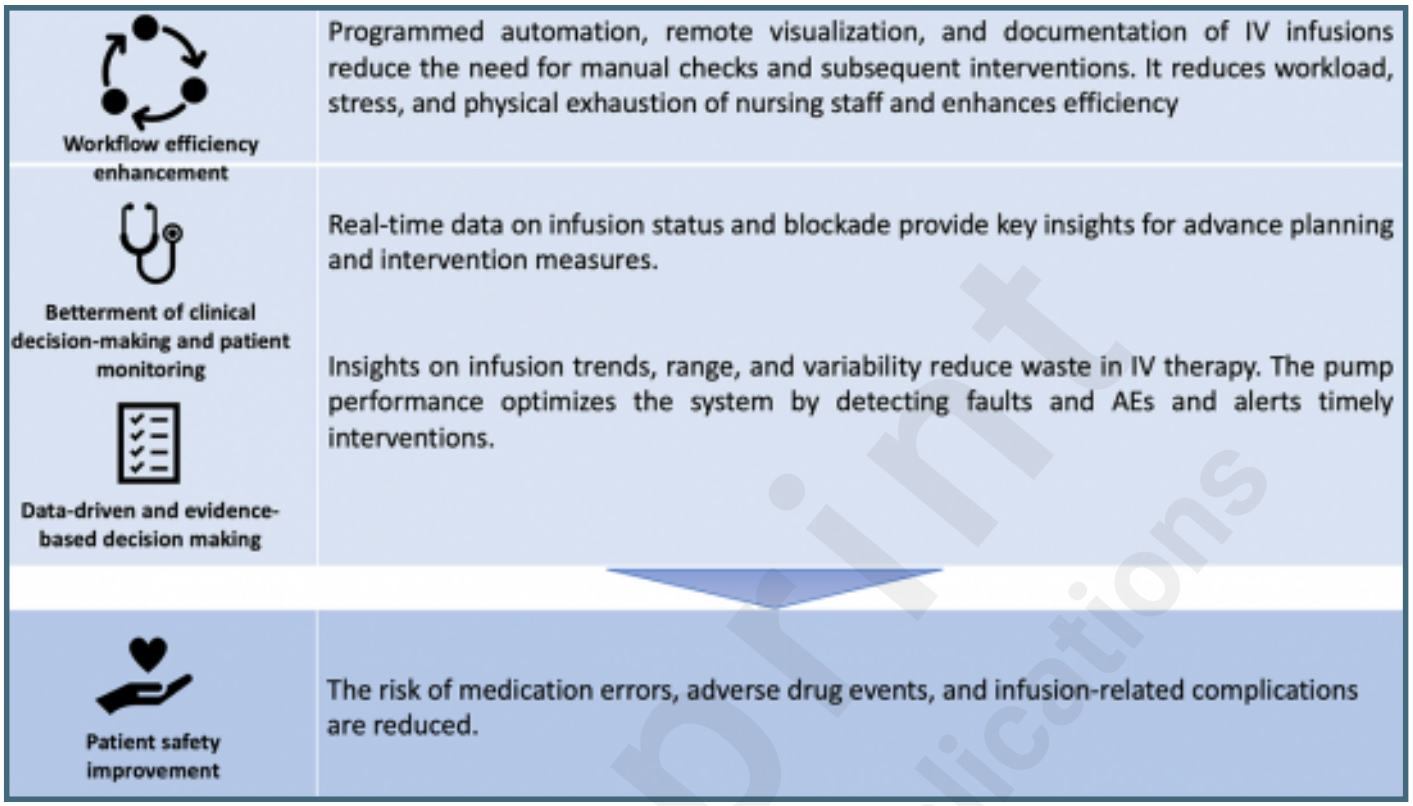
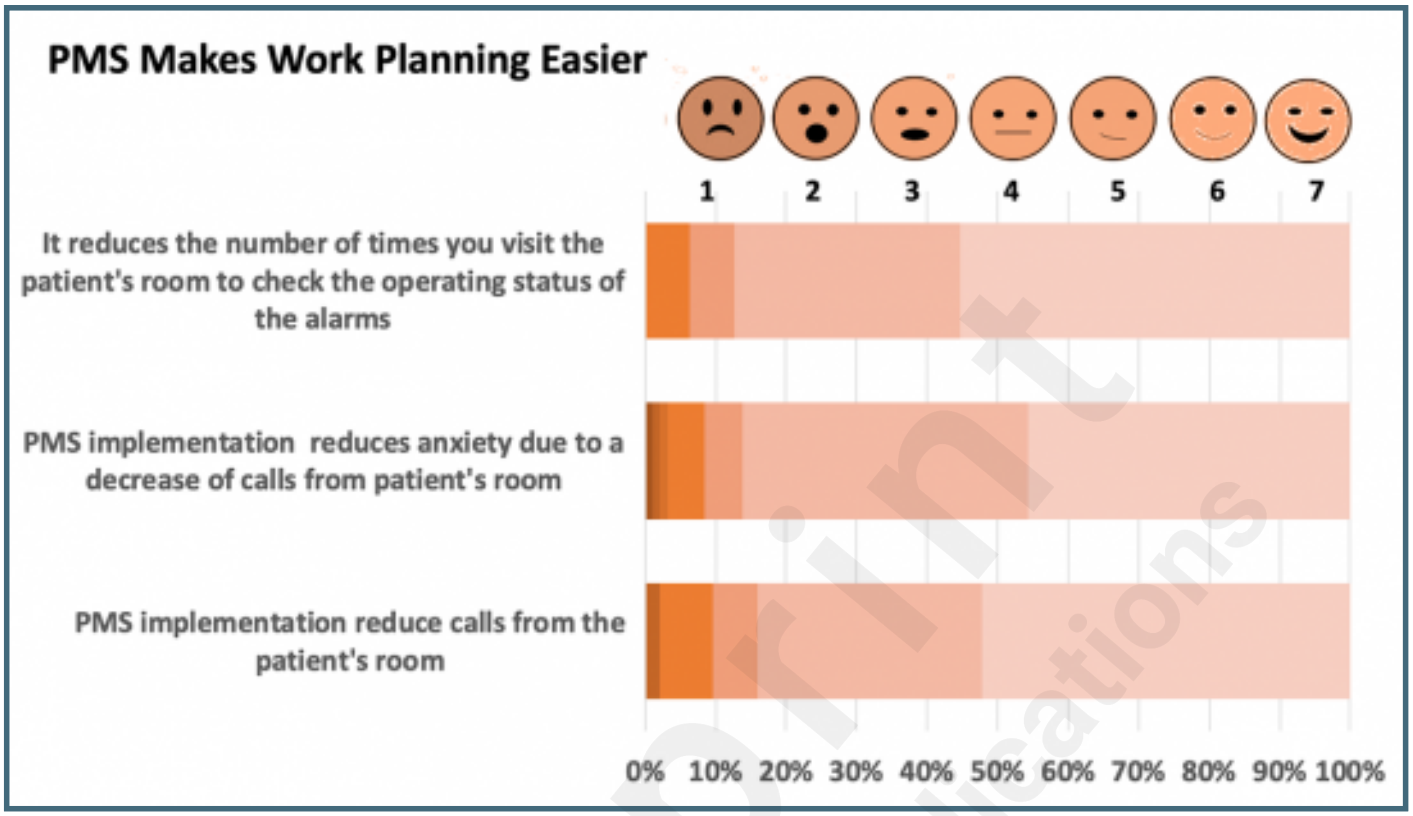
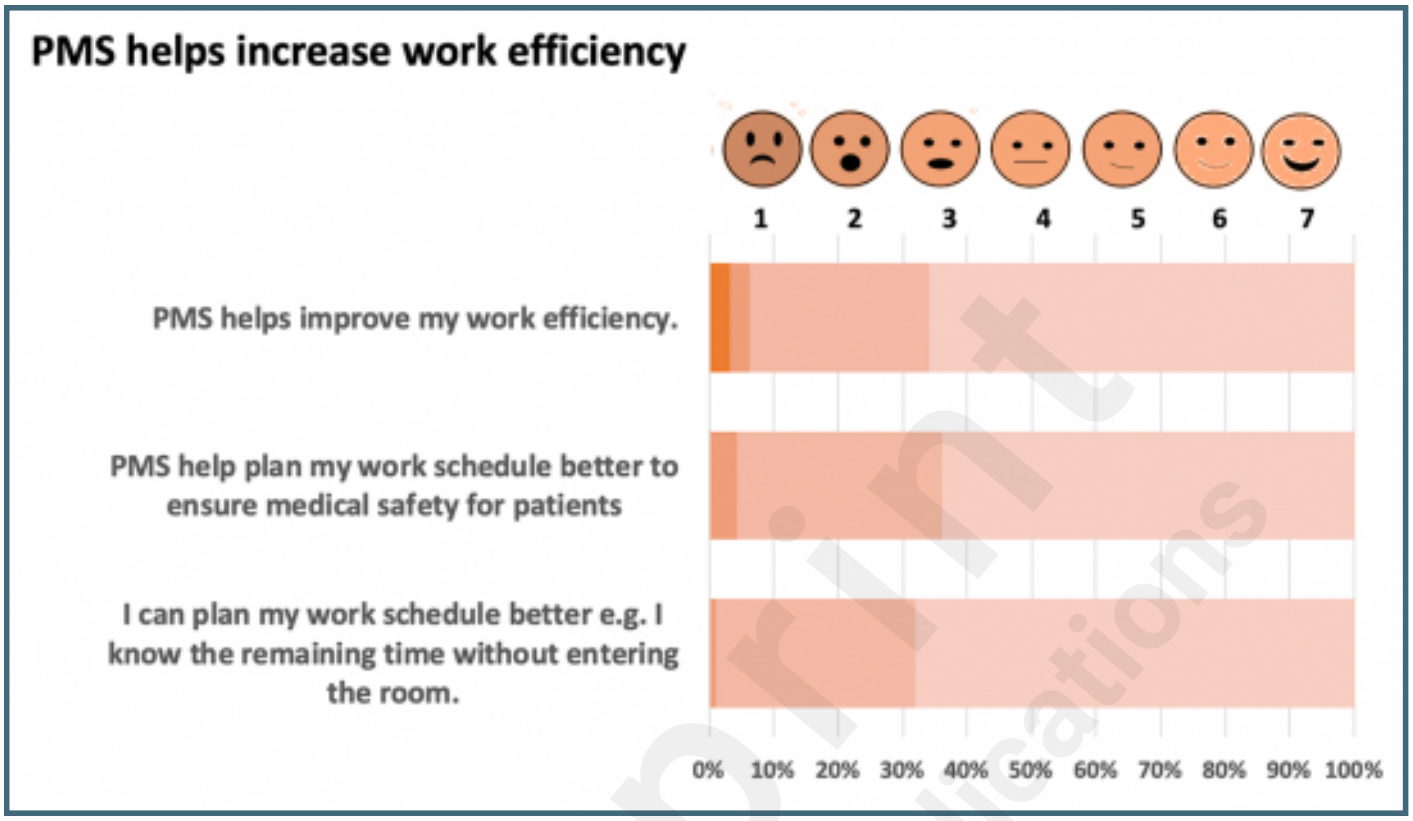


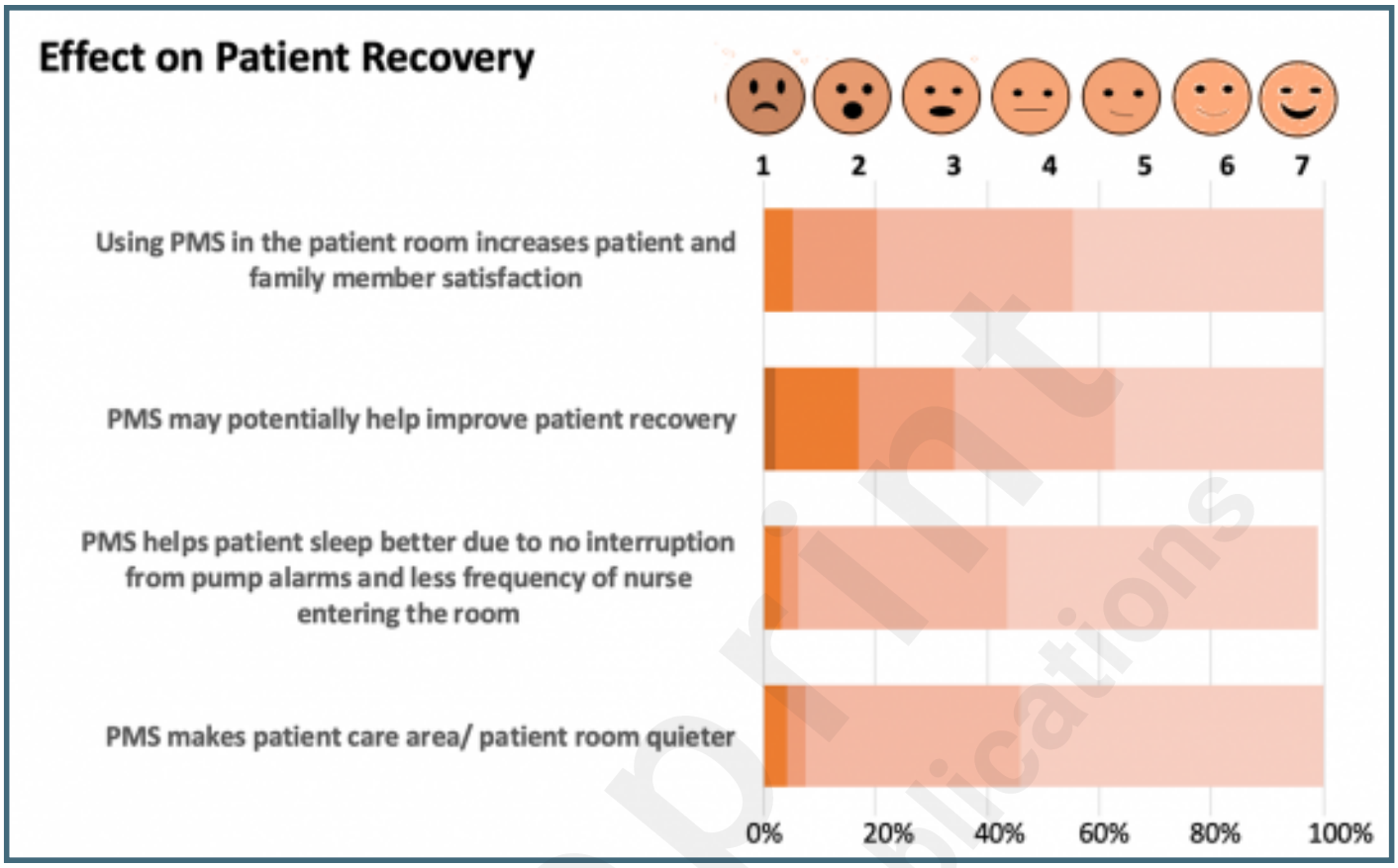
PMS impact on work planning and efficiency.



Work efficiency with PMS integration in the workflow.



Effect of PMS on patient recovery.



Multimedia Appendixes

Pump monitoring system (PMS) usage survey.
URL: http://asset.jmir.pub/assets/523dd156650eee760a801d0cb2a80092.docx