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Health Technology Assessment Unit (TAU) of the MUHC

Workstations on Wheels: Evidence, Implementation Considerations, and Lessons for the MUHC

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Report prepared for the Technology Assessment Unit (TAU) of the McGill University Health Centre (MUHC)

by

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- Jasmine Lee Hill, RN, M.Sc.(N), CMSN(C), Nursing Practice Consultant, Professional practice, education, workforce organization and research, Nursing Directorate of the MUHC

REPORT REQUESTOR

This report was requested by Jasmine Lee Hill, Nursing Practice Consultant at the MUHC, on September 12, 2025, to support decision-making regarding the adoption of mobile nursing workstations (Workstations on wheels or WOWs) as part of the hospital's digital transformation of clinical workflows.

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Type of recommendation	Explanation
Approved	• Evidence for relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, is sufficiently strong to justify a recommendation that the technology be accepted, used and funded through the institutional operating budget
Approved for evaluation	• There is a reasonable *probability* that relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, are favorable but the evidence is not yet sufficiently strong to support a recommendation for permanent and routine approval. • The evidence is sufficiently strong to recommend a *temporary* approval in a restricted population for the purposes of evaluation, funded through the institutional operating budget.
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BACKGROUND

- Accurate and timely clinical documentation is essential for safe, effective care, and the shift to electronic health records has accelerated the digital transformation of clinical workflows. As part of this transformation, the McGill University Health Centre (MUHC) has recently launched the ENACT (Empowering Nurses with AI for Care Transformation) program to optimize nursing workflows through artificial intelligence and digital tools.
- Mobile nursing workstations (Workstations on Wheels or WOWs) are a key tool in this transformation, designed to reduce documentation delays, minimize errors, and enhance point-of-care delivery. However, determining the most efficient documentation approach, whether at the bedside or nursing station, requires consideration of nurse workflows, technology usability, and clinical context. To inform this initiative, the Technology Assessment Unit (TAU) evaluated the effectiveness of WOWs in improving workflows and identified key considerations for their successful adoption at the MUHC.

POLICY QUESTION

Will adoption of mobile nursing workstations help nurses deliver safe, efficient, and patient-centred care?

EVALUATION QUESTIONS (Objectives of this report)

- To review the safety and effectiveness of nursing workstations on wheels (WOWs) compared to standard non-mobile workstations to improve workflow efficiency in an in-patient hospital setting;
- To review general guiding principles for the adoption of WOWs.

METHODS

We conducted a literature search on PubMed, Medline and Embase to identify studies that evaluated the impact of mobile nursing workstations on point-of-care electronic documentation and nurse satisfaction. We also reviewed articles and publications on implementation factors for adopting WOWs.

RESULTS

Evidence of impact on clinical workflow:

1. **Documentation timeliness and accuracy**: Published evidence, derived from observational and qualitative studies, indicates that WOWs were associated with a higher proportion of "timely" entries (documentation within 60 min) compared to documentation at the nursing station. However, **mobility alone did not ensure accuracy or timeliness**—transcription from paper into WOWs negated benefits, and limited WOW availability further delayed documentation.

2. **Nurse perception of utility**: Nurses were generally positive about WOWs due to their mobility, large screens and accessibility for real-time charting. They valued being given a choice for documentation location, preferring bedside documentation for vital signs, pain assessments, and admissions, while opting for stationary workstations for more complex or narrative documentation. WOWs were particularly appreciated for medication administration, offering a convenient work surface and access to supplies. However, it was noted that **medication administration is among the most complex workflows to integrate with WOWs,** due to the need to coordinate patient and cart in constricted patient rooms. In general, operational issues, such as bulkiness, connectivity, and fear of eroding patient rapport, limit the perceived utility of WOWs.

3. **Patient-centred care and safety**: We did not identify any studies evaluating the direct impact of WOWs on patient safety, such as reduction in medication errors or infection risk.

Key considerations:

The successful adoption and long-term sustainability of mobile nursing workstations (WOWs) depend on thoughtful attention to key design, ergonomics, and local implementation factors.

- **Ergonomics:** Factors such as bulky cart size, manoeuvrability, height and lateral adjustability, and workspace layout, were repeatedly raised as issues directly influencing nurses' comfort, mobility, and willingness to use WOWs consistently, thereby affecting documentation timeliness and workflows.

- **Bedside vs. outside-the-room WOWs:** Experience from other hospitals indicates choice of WOW location requires aligning cart functionality with specific clinical tasks and user preferences to minimize workflow disruption and safety risks:

- **Utility for medication administration**: Bedside WOWs equipped with medication cabinets and barcode scanners were particularly appreciated by nurses as a means to reduce medication errors, but qualitative studies have highlighted the challenges of wheeling bulky carts into narrow patient rooms, a key implementation challenge with no easy solution. Some hospitals have moved towards room-based computers and even adjustable wall-mounted computers that extend from the hallway into patient rooms on a long swing arm.
- **Documentation timeliness and errors**: Limited evidence indicates that timeliness and accuracy were not improved with the use of outside-the-room WOW carts that required transcription from paper notes to WOWs.
- **Infection risk**: Although we did not find direct evidence showing that WOWs cause infections, it is prudent to assume that WOWs, like similarly shared mobile medical equipment, carry infection transmission risk and to build in mitigation strategies, including cart design (antimicrobial material) and hygiene policies (regular disinfection and hand hygiene).

- **Change management**: Successful integration into existing clinical workflows is dependent on the early involvement of nurses in the planning, implementation and evaluation phases to achieve buy-in and align WOW functionality with real-world needs. Training, user testing and feedback mechanisms are needed for continuous improvement.

CONCLUSIONS

- Mobile nursing workstations represent a useful enabling technology within the MUHC's broader digital transformation strategy and the ENACT program to enhance nursing efficiency and care quality.
- The current evidence suggests that, when ergonomically designed and well integrated into hospital IT systems, WOWs may reduce documentation delays, streamline workflows, and improve nursing satisfaction.
- However, these advantages are not guaranteed by mobility alone; successful adoption requires attention to ergonomics, ease of technology integration into current workflows, and existing documentation culture. Training, user testing and engagement, and ongoing performance monitoring are critical to ensuring that WOWs add value to clinical practice without compromising patient interaction or safety.
- As part of the ENACT rollout, implementing pilot evaluations with clear performance indicators, including workflow efficiency, technology usability, and

infection rates, will help guide sustainable scaling and continuous improvement across MUHC sites.

BEST PRACTICE RECOMMENDATIONS

1. **Prioritize ergonomic and workflow-centred design:**

   - Experiential evidence indicates that ergonomically-designed WOWs that are well integrated into hospital IT systems may reduce documentation delays and streamline workflows. Nonetheless, mobility alone does not guarantee benefit; successful adoption requires attention to ergonomics, ease of technology integration into current workflows, and existing documentation culture. There is also a need to evaluate whether outside-the-room WOW carts offer the same point-of-care documentation benefits as beside WOWs.

2. **Engage end users and support change management:**

   - Successful integration into existing clinical workflows, particularly medication administration and bedside documentation, requires early involvement of nurses in design selection, piloting, and evaluation to align WOW functionality with real-world needs. Comprehensive education, user testing and engagement, and feedback mechanisms are needed for continuous improvement.

3. **Implement continuous evaluation and quality monitoring:**

   - Establish clear performance indicators, such as workflow efficiency, usability, and staff satisfaction, to guide ongoing optimization. Regularly reassess ergonomics, maintenance, and infection control to ensure WOWs continue to enhance documentation timeliness, safety, and patient-centred care.

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CONTEXTE

- Une documentation clinique précise et opportune est essentielle à la sécurité et à l'efficacité des soins, et le passage aux dossiers de santé électroniques a accéléré la transformation numérique des flux de travail cliniques. Dans le cadre de cette transformation, le Centre universitaire de santé McGill (CUSM) a récemment lancé le programme ENACT (Autonomisation des infirmières et infirmiers par l'IA pour la transformation des soins) afin d'optimiser les flux de travail infirmiers grâce à l'intelligence artificielle et aux outils numériques.
- Les postes de travail infirmiers mobiles (PTM) sont un outil clé de cette transformation. Ils sont conçus pour réduire les délais de documentation, minimiser les erreurs et améliorer la prestation des soins au chevet du patient. Toutefois, déterminer l'approche de documentation la plus efficace, que ce soit au chevet du patient ou au poste de soins infirmiers, exige de tenir compte des flux de travail infirmiers, de la convivialité de la technologie et du contexte clinique. Afin d'éclairer cette initiative, l'Unité d'évaluation des technologies et des modes d'intervention en santé du CUSM (TAU) a évalué l'efficacité des PTM pour améliorer les flux de travail et a cerné les principaux éléments à prendre en compte pour leur adoption réussie au CUSM.

QUESTION DÉCISIONNELLE

L'adoption de postes de travail mobiles pour les soins infirmiers permettra-t-elle aux infirmières de prodiguer des soins sécuritaires, efficaces et centrés sur le patient ?

QUESTION D'ÉVALUATION (Objectifs du présent rapport)

- Examiner la sécurité et l'efficacité des postes de travail mobiles pour les soins infirmiers par rapport aux postes de travail fixes standard afin d'améliorer l'efficacité du flux de travail en milieu hospitalier ;
- Examiner les principes directeurs généraux pour l'adoption des postes de travail mobiles pour les soins infirmiers.

MÉTHODES

Nous avons effectué une recherche bibliographique sur PubMed, Medline et Embase afin d'identifier les études évaluant l'impact des postes de travail mobiles pour les soins

infirmiers sur la documentation électronique au chevet du patient et la satisfaction des infirmières. Nous avons également examiné les articles et publications portant sur les facteurs de mise en œuvre de ces postes de travail.

RÉSULTATS

Impact sur le flux de travail clinique :

1. **Rapidité et exactitude de la documentation** : Les données probantes, issues d'études observationnelles et qualitatives, indiquent que les postes de travail mobiles sont associés à une proportion plus élevée de saisies « rapides » (documentation en moins de 60 minutes) comparativement à la documentation au poste de soins infirmiers. Toutefois, **la mobilité seule ne garantit ni l'exactitude ni la rapidité** : la transcription des documents papier vers les postes mobiles annule les avantages, et la disponibilité limitée de ces postes retarde davantage la documentation.

2. **Perception de l'utilité par les infirmières** : Les infirmières ont généralement apprécié les postes de travail mobiles en raison de leur mobilité, de leurs grands écrans et de leur accessibilité pour la saisie de données en temps réel. Elles ont apprécié de pouvoir choisir le lieu de documentation, préférant la documentation au chevet du patient pour les signes vitaux, les évaluations de la douleur et les admissions, et optant pour des postes de travail fixes pour une documentation plus complexe ou narrative. Les postes mobiles ont été particulièrement appréciés pour l'administration des médicaments, offrant une surface de travail pratique et un accès aux fournitures. Cependant, il a été noté que **l'administration des médicaments est l'un des flux de travail les plus complexes à intégrer à l'aide de postes de travail mobiles**, en raison de la nécessité de coordonner le patient et le chariot dans des chambres de patients exiguës. De manière générale, des problèmes opérationnels, tels que l'encombrement, la connectivité et la crainte de nuire à la relation avec le patient, limitent l'utilité perçue des postes de travail mobiles.

3. **Sécurité et soins centrés sur le patient** : Nous n'avons identifié aucune étude évaluant l'impact direct des postes de travail mobiles sur la sécurité des patients, notamment la réduction des erreurs médicamenteuses ou du risque d'infection.

Points clés à considérer :

L'adoption réussie et la pérennité des postes de travail mobiles pour les soins infirmiers reposent sur une attention particulière portée à la conception, à l'ergonomie et aux facteurs locaux de mise en œuvre.

- **Ergonomie** : Des facteurs tels que l'encombrement du chariot, sa maniabilité, son réglage en hauteur et latéral, ainsi que l'aménagement de l'espace de travail, ont été fréquemment soulevés comme des enjeux influençant directement le confort, la mobilité et la volonté des infirmières d'utiliser les postes mobiles de manière régulière, ce qui a un impact sur la rapidité de la documentation et les flux de travail.

- **Postes de travail mobiles au chevet du patient versus hors de la chambre** : L'expérience d'autres hôpitaux indique que le choix de l'emplacement du poste de travail mobile nécessite d'adapter les fonctionnalités du chariot aux tâches cliniques spécifiques et aux préférences des utilisateurs afin de minimiser les perturbations des flux de travail et les risques pour la sécurité :

    - **Utilité pour l'administration des médicaments** : Les postes mobiles, équipés d'armoires à pharmacie et de lecteurs de codes-barres, ont été particulièrement appréciés des infirmières comme moyen de réduire les erreurs médicamenteuses. Cependant, des études qualitatives ont mis en évidence les difficultés liées au déplacement de chariots encombrants dans les chambres étroites des patients, un défi majeur de mise en œuvre sans solution simple. Certains hôpitaux ont opté pour des ordinateurs en chambre, voire des ordinateurs muraux réglables qui se déploient du couloir jusqu'aux chambres des patients grâce à un long bras articulé.

    - **Délais et erreurs de documentation** : Des données probantes limitées indiquent que les délais et l'exactitude n'ont pas été améliorés par l'utilisation de chariots mobiles situés à l'extérieur de la salle, qui nécessitaient la transcription des notes papier vers des postes de travail mobiles.

    - **Risque d'infection** : Bien que nous n'ayons pas trouvé de preuves directes démontrant que les postes mobiles causent des infections, il est prudent de supposer que ces postes mobiles, comme tout équipement médical partagé, comportent un risque de transmission d'infections. Il est donc nécessaire de mettre en place des stratégies d'atténuation, notamment la

conception des chariots (matériaux antimicrobiens) et des politiques d'hygiène (désinfection régulière et hygiène des mains).

- **Gestion du changement** : L'intégration réussie aux flux de travail cliniques existants repose sur l'implication précoce des infirmières dans les phases de planification, de mise en œuvre et d'évaluation afin d'obtenir leur adhésion et d'aligner les fonctionnalités de postes de travail mobiles sur les besoins réels. Des formations, des tests d'utilisabilité et des mécanismes de retour d'information sont nécessaires pour une amélioration continue.

CONCLUSIONS

- Les postes de travail mobiles pour infirmières constituent une technologie habilitante précieuse dans le cadre de la stratégie de transformation numérique du CUSM et du programme ENACT, visant à améliorer l'efficacité des soins infirmiers et la qualité des soins.
- Les données probantes actuelles suggèrent que, lorsqu'ils sont conçus de manière ergonomique et bien intégrés aux systèmes informatiques hospitaliers, les postes de travail mobiles peuvent réduire les délais de documentation, simplifier les flux de travail et améliorer la satisfaction du personnel infirmier.
- Toutefois, la mobilité à elle seule ne garantit pas ces avantages ; une adoption réussie exige une attention particulière à l'ergonomie, à la facilité d'intégration de la technologie aux flux de travail actuels et à la culture de documentation existante. La formation, les tests d'utilisabilité et la mobilisation des utilisateurs, ainsi que le suivi continu du rendement, sont essentiels pour garantir que les postes de travail mobiles ajoutent de la valeur à la pratique clinique sans compromettre l'interaction avec les patients ni leur sécurité.
- Dans le cadre du déploiement d'ENACT, la mise en œuvre d'évaluations pilotes avec des indicateurs de performance clairs, notamment l'efficacité des flux de travail, la facilité d'utilisation de la technologie et les taux d'infection, contribuera à orienter une mise à l'échelle durable et une amélioration continue dans tous les sites du CUSM.

RECOMMANDATIONS DE BONNES PRATIQUES

1. Prioriser la conception ergonomique et centrée sur les flux de travail :

- Les données expérientielles montrent que les postes de travail mobiles ergonomiques et bien intégrés aux systèmes informatiques hospitaliers peuvent réduire les délais de documentation et optimiser les flux de travail. Toutefois, la mobilité seule ne garantit pas les bénéfices ; une adoption réussie nécessite une attention particulière à l'ergonomie, à la facilité d'intégration de la technologie aux flux de travail existants et à la culture de documentation en place. Il convient également d'évaluer si les postes de travail mobiles hors chambre offrent les mêmes avantages en matière de documentation au chevet du patient que les postes mobiles placés à côté du patient.

2. Impliquer les utilisateurs finaux et accompagner la gestion du changement :

- Une intégration réussie aux flux de travail cliniques existants, notamment pour l'administration des médicaments et la documentation au chevet du patient, requiert l'implication précoce des infirmières dans la sélection, le pilotage et l'évaluation de la conception afin d'aligner les fonctionnalités des postes mobiles sur les besoins réels. Une formation complète, des tests d'utilisabilité, une implication des utilisateurs et des mécanismes de retour d'information sont nécessaires pour une amélioration continue.

3. Mettre en œuvre une évaluation continue et un suivi de la qualité :

- Établir des indicateurs de performance clairs, tels que l'efficacité des flux de travail, la facilité d'utilisation et la satisfaction du personnel, afin d'orienter l'optimisation continue. Réévaluez régulièrement l'ergonomie, la maintenance et le contrôle des infections afin de garantir que les postes de travail mobiles continuent d'améliorer la rapidité de la documentation, la sécurité et les soins centrés sur le patient.

LIST OF ABBREVIATIONS

AI	Artificial Intelligence
EHR	Electronic Health Record
HTA	Health Technology Assessment
IT	Information Technology
MUHC	McGill University Health Centre
TAU	MUHC Technology Assessment Unit
WOW	Workstation on Wheels

WORKSTATIONS ON WHEELS: EVIDENCE, IMPLEMENTATION CONSIDERATIONS, AND LESSONS FOR THE MUHC

1. BACKGROUND

Accurate and timely clinical documentation is crucial for safe and effective patient care. The shift towards electronic health records has ushered in era of digital transformation aimed at improving the quality and efficiency of clinical workflows. The adoption of mobile nursing workstations is one tool in this transformation portfolio, intended to reduce delayed documentation and charting errors while improving point-of-care delivery.

However, questions remain about the most efficient location and modality for nurse clinical documentation: at the bedside with permanently in-room or handheld computers; at the bedside with mobile workstations on wheels; or on computers at the nursing station. The selection of the most appropriate solution is a complex organizational decision that must consider current nurse workflows and workloads, technology usability and infrastructure, and feasibility aspects such as space and infection control.

1.1 Context for this evaluation

In September 2025, the MUHC launched the ENACT (Empowering Nurses with AI for Care Transformation) program, a major institutional initiative to enhance nursing efficiency and patient-centred care through digital innovation.[1] Developed in response to an internal MUHC study that revealed that nurses spend a substantial portion of their shifts away from the bedside due to documentation and administrative tasks, ENACT aims to integrate artificial intelligence (AI) solutions that streamline administrative processes, optimize workload distribution, and support clinical decision-making. One component within ENACT aims to deploy mobile nursing workstations (Workstations on Wheels or WOWs) equipped with AI-enabled tools to facilitate real-time documentation, fair patient assignment, task prioritization, and safe end-of-shift handovers.

As a critical first step in ensuring the success and sustainability of the ENACT program, TAU was requested to evaluate the effectiveness and implementation considerations of WOWs.

2. POLICY AND EVALUATION QUESTIONS

2.1 Policy question

- Will adoption of mobile nursing workstations help nurses deliver safe, efficient, and patient-centred care?

2.2 Evaluation questions (Objectives of this report)

- To review the safety and effectiveness of nurse workstations on wheels (WOWs) compared to standard non-mobile workstations to improve workflow efficiency in an in-patient hospital setting;
- To review general guiding principles for the adoption of WOWs.

3. METHODS

3.1 Literature search

We conducted a literature search to identify published articles or guidance documents on mobile workstations by searching PubMed, Medline and Embase. The most recent search was conducted on October 6, 2025 using the following keywords: "workstation on wheels" OR "bedside documentation" OR "point of care documentation".

4. WORKSTATION ON WHEELS: DEFINITION AND KEY FEATURES

4.1 Definition

- Nurse workstations on wheels, also known as WOW carts, allow nurses to bring information and supplies directly to a patient's bedside, with the rationale that such point-of-care delivery would allow for improved accessibility, documentation efficiency and the potential for reduced transcription and medication errors. Bedside documentation, also know as point-of-care documentation, refers to electronic documentation occurring next to or in close proximity to the patient.[2]

- Lack of access to point-of-care electronic documentation may lead nurses to use the quickest available means of documenting clinical information e.g. scribbling vital signs on scraps of paper, which can lead to transcription errors.
- WOW carts are designed to hold computers and other equipment, and can be equipped with lockable drawers for dispensing medications.

4.2 Key features of WOWs

- **Mobile and ergonomic:** Designed to be easily manoeuvrable and brought to the point of care.
- **Wireless computer:** Meant to have a battery life that supports a full work shift while easily integrating with the hospitals IT systems.
- **Infection control:** Equipped with antimicrobial surfaces and easy to clean components.
- **Optional features:** Some carts come with lockable medicine-dispensing drawers.

5. EVIDENCE ON EFFECTIVENESS AND SAFETY OF WOWS

Table 1 below summarizes the available evidence on the impact of WOWs on documentation timeliness and nurse perception of their usability. Appendix 1 includes details of the individual studies reviewed.

5.1 Documentation timeliness & accuracy

- Evidence from two evaluations, including a large electronic health record (EHR) log analysis of 41,286 entries,[3] shows that WOWs generally improve **timeliness** of nursing electronic documentation, with bedside and WOW documentation more likely to occur within one hour of care whereas nurse station documentation is often delayed >2 hours (documentation within 60 minutes: 43% nurse station vs. 68% bedside vs. 59% WOWs; $p<0.05$).[4] Documentation delays averaged 134 minutes at the nurses' station, 65 minutes at the bedside, and 55 minutes when using a WOW ($p=0.097$). This is plausibly because staff document immediately rather than later from memory.

- Nonetheless, these studies raise several caveats:

- In situations where WOWs were stationed outside patient rooms and handwritten vital signs were transcribed from paper to WOWs, timeliness and accuracy were not improved.[5]
- The number of available WOWs on the wards was considered a limitation to timely documentation, particularly if these computers were already in use by other clinical staff.[5]

Table 1. Summary of the evidence

Outcome	Key Findings	Interpretation of the Evidence
Documentation Timeliness	• Across 2 studies, WOWs were associated with a **higher proportion of "timely" entries (< 60 min)** compared to documentation at the nursing station.[3,4]	• WOWs generally outperform stationary stations but may be less efficient than lightweight, permanently in-room or handheld solutions when mobility is constrained.
Documentation Accuracy	• 1 study (n=270 observations) reported a 16.8% **error rate** with paper documentation of vital signs vs. 15.2% with WOWs outside patient room (paper to computer), vs. 5.6% with a tablet PC affixed to the vital signs monitor in the patient's room.[5]	• Mobility alone does not ensure accuracy and timeliness; • Transcribing from paper to WOWs resulted in similar error rate as paper documentation, and timeliness was impacted by WOW availability.
Nurse Perception of Utility	• Across 4 studies, nurse feedback supports WOWs for **mobility, immediate documentation, and medication administration**.[2-4,6] • Concerns were raised about **balancing time** spent on patient care vs. bedside documentation, **manoeuvrability** and **charging logistics, and hallway congestion**. • Several studies reported that nurses value **choice of documentation location**, with a preference for documenting vital signs and pain assessments at the bedside, while favoring the nurses' station for patient education and care plans.[3,4,6] • The **main barrier** to bedside documentation was patient interruptions and care demands, while the primary barrier at the nurses' station was staff interruptions.[4]	• Nurses perceive that WOWs offer workflow advantages, particularly for medication delivery and access to supplies; however, operational issues, such as bulkiness, connectivity, and fear of eroding patient rapport, limit perceived benefit.
Patient safety	No studies identified	

5.2 Nurse perceived utility

5.2.1 Bedside vs. Outside-the-Room WOWs

Table 2 lists nurse-reported advantages and disadvantages of bedside vs. outside-the-room WOWs. Nurses valued being given a **choice for documentation location**, with quick charting such as vitals and pain assessment being preferred at the point of care, while more detailed charting including care plans were preferred at the nursing station.[3,4,6]

Manoeuvring and congestion:

- While bedside WOWs were preferred for **medication documentation** because their shelves offered a convenient surface for writing and carrying supplies directly into the room, it was noted that **medication administration is among the most complex workflows** to integrate with WOWs, as it involves coordinating the cart, patient, and medication storage in confined spaces.[2,3,6]
    - Experience across some hospitals found that nurses often left bulky WOWs in hallways because they were difficult to manoeuvre in and out of patient rooms, but the introduction of **bar-coded medication administration** and bedside barcode scanning necessitated moving the carts into rooms, prompting complaints about cart size and manoeuvrability.
- To address these concerns, some hospitals moved towards the adoption of smaller, lighter carts or room-based computers to balance accessibility, ergonomics, and cost, but their experience highlighted that no single cart design suits all users or clinical contexts. Some hospitals, like Duke University and Health System, have experimented with built-in alcoves with fold-down workstations in hallways, and adjustable wall-mounted computers installed in the hallway but capable of swinging into the room on a long arm.[7]

Documentation timeliness and accuracy:

- Nurses appreciated that bedside WOWs allow for real-time documentation and quick data verification with the patient. However, both timeliness and accuracy benefits were lost with outside-the-room WOWs when nurses had to later transcribe paper notes into the WOWs, or if carts were not easily accessible due to connectivity issues or being occupied by other users.

Patient care and safety:

- Some nurses perceived that bedside documenting takes attention away from patient, and expressed concerns about patients and families feeling ignored when not looking directly at them.[2]
- One study identified patient interruptions and care demands as the **main barrier** to bedside documentation, while staff interruptions were the primary barrier at the nurses' station.[4]

5.2.2 Nurse overall satisfaction

- Nurses were generally positive about WOWs due to their **mobility**, large screens and accessibility for real-time charting.[2-4,6]
- The principal concerns raised with WOWs were their tendency to be cumbersome and congest rooms and hallways, and issues pertaining to connectivity and battery life.[2-4,6]

5.3 Infection control

- While we did not identify any studies evaluating the direct impact of WOWs on patient safety and infection transmission, there is an inherent risk that WOWs (like similarly shared mobile medical equipment) can harbour potentially harmful microbes and thus contribute to nosocomial infection transmission.[8]
- There is indirect evidence that high-touch surfaces on WOWs can accumulate microbes, and that WOWs as highly shared devices, can serve as vectors for transmission. [9,10]
- Therefore, it is prudent to assume that WOWs carry infection transmission risk and to build in mitigation strategies, including design (smooth surfaces, antimicrobial materials, easy-to-clean parts) and cleaning and disinfection protocols, while reinforcing hand hygiene policies.

Table 2. Advantages and disadvantages of bedside vs. outside-the-room WOWs

Outcome		Advantages	Disadvantages
Medication administration	Bedside WOWs	• Integrated shelves provide a writing surface and allow transport of medications and supplies into rooms • Perceived as beneficial for patient safety in reducing medication errors.	• Requiring heavy, bulky carts in the patient room adds to complexity of workflows, needing coordination of cart, patient, and medication storage in confined spaces.
	Outside-room WOWs	• Doesn't crowd patient room	• Barcode scanning of medications not possible; increased risk of transcription or administration errors
Documentation timeliness & transcription errors	Bedside WOWs	• Enables real-time documentation, therefore fewer chances for transcription errors	• Interruptions by family and patient may delay documentation;
	Outside-room WOWs	• Data entry may be less rushed with fewer patient interruptions	• Requires nurses to keep information in their heads as they go back and forth, or scribble on scraps of paper, increasing risk of transcription errors when data later entered into WOW. • Timeliness impact lost if carts in use by other staff.
Manoeuvring and congestion	Bedside WOWs	• Eliminates need for nurse to move back and forth between WOW and patient.	• Bulky carts hard to manoeuvre into rooms.
	Outside-room WOWs	• Reduces room congestion and easier to navigate.	• Causes hallway congestion.
Direct patient care	Bedside WOWs	• Supports bedside presence, allowing greater patient engagement in their care plans.	• Some nurses perceive bedside charting as impersonal or distracting during patient interactions.
	Outside-room WOWs	• Allows full attention to patient.	• Delays documentation and reduces visibility of real-time data.

5.4 Strength of the evidence & limitations

Study designs: Much of the literature is observational, single-site before/after evaluations, or qualitative, limiting our certainty in the quality of the evidence. The large EHR log analysis was limited by the pitfalls of administrative data: potential missing data, coding errors, and inconsistent documentation.

Generalizability: Both quantitative and qualitative outcomes depend heavily on local factors such as the current culture of electronic documentation, IT infrastructure and local clinical settings. Implementation details, key to successful adoption and sustainability, are often not reported.

Outcomes measured: Most studies measure intermediate outcomes (time on tasks, documentation timeliness, nurse satisfaction). Direct evidence for patient safety outcomes (fewer adverse events, mortality, infection rates) is limited.

6. KEY CONSIDERATIONS WHEN ADOPTING AND IMPLEMENTING WOWS

- **Ergonomical factors** such as bulky cart size, manoeuvrability, height and lateral adjustability, and workspace layout, were repeatedly raised as issues directly influencing nurses' comfort, mobility, and willingness to use WOWs consistently.
    - In response to these challenges, in 2004, Professor Alan Hedge, director of the Human Factors and Ergonomics Laboratory at Cornell University in Ithaca, N.Y., developed an ergonomics checklist for mobile computing carts to facilitate decision-making in the choice of carts. The checklist, drawn from interviews with nursing executives and hospital ergonomists, as well as vendor offerings at that time, is focused on major risk factors due to poor posture or difficulty in manoeuvring carts.[11]
- In addition to ergonomics, Table 3 lists major domains that should be carefully considered before adoption, including local context and change management.

Table 3. Key considerations for adopting WOWs

Criteria	Key considerations	Rationale/Implications
Ergonomics and usability	• Compact, lightweight design that fits in hallways and patient rooms. • Stable, quiet wheels to reduce noise and vibration. • Adjustable height and monitor position for user comfort. • Adequate surface area for writing and organizing supplies.	• Poor ergonomics and noisy or unstable carts can cause fatigue, musculoskeletal strain, and workflow disruption. • Well-designed carts improve staff satisfaction and efficiency.
Battery life and charging solutions	• Long-lasting batteries to support a full work shift • Centralized charging stations or hot-swappable batteries. • Clear charging protocols and maintenance schedules.	• Inadequate battery life or inconsistent charging can cause downtime, workflow delays, and frustration among nurses.
IT connectivity and interoperability of systems	• Reliable Wi-Fi coverage throughout clinical areas. • Seamless integration with EHR, barcode medication administration, and other clinical systems. • Rapid login and user authentication.	• Poor connectivity or integration reduces timeliness of documentation and increases risk of data entry errors.
Durability and mobility	• Robust construction to withstand frequent movement and cleaning. • Smooth, lockable wheels and easy steering. • Lightweight materials that balance stability and portability.	• Frequent use and transport expose carts to mechanical stress; durable materials reduce maintenance and replacement costs.
Infection control	• Smooth, nonporous, easy-to-clean surfaces. • Compatibility with hospital-grade disinfectants. • Defined cleaning protocols between patient encounters.	• WOWs move between rooms and can transmit pathogens if not properly cleaned; infection control design and practices are essential for patient safety.
Patient-clinician relationship	• Consider impact on patient-provider rapport and building a relationship of confidence.	• Some nurses perceive bedside charting as impersonal or distracting during patient interactions.
Training and change management	• Do staff have confidence and knowledge about the technology? • Will the technology require significant changes in care pathways and organizational routines?	• Incomplete understanding of current culture surrounding documentation and potential disruptions to workflow can cause poor uptake.
Acquisition and operating costs	• Costs (hardware, software, accessories, IT support) should be justified with respect to expected benefits, and other available systems.	• Promotes a judicious use of resources
Environmental impact	Are the technologies environmentally sustainable?	

7. CONTINUOUS EVALUATION

7.1 Post-adoption monitoring

- Because randomized controlled trials or robust comparative studies are rare in this context, it is important to collect real-world evidence for ongoing evaluation and improvement.
- A potential evaluation could use a **controlled before-after pilot** with mixed methods and include:
  - Quantitative time-and-motion and outcome metrics (see Table 4) collected for a pre-specified time before and after the intervention.
  - Staff surveys (usability, perceived efficiency) or focused qualitative interviews with nurses and clinical staff.

Table 4. Example key performance indicators for evaluation

Metric Category	Indicator
Process/workflow	
	Time spent walking per shift (metres or minutes) Time spent on documentation tasks per shift and % documented within 60 minutes of care Number of interruptions during charting
Documentation quality	
	Error rate (accuracy of documenting in WOWs vs. at nurse station) Completeness of required fields
User experience	
	Nurse usability and satisfaction survey Patient survey of perceived nurse availability Connectivity and battery failure incidents
Cost impact	
	Acquisition and operating costs vs. expected savings (e.g. due to reduction in medication errors or documentation delays)
Safety	
	Medication administration errors Incident reports related to documentation delays or medication errors Nosocomial infection rates

8. KEY TAKEAWAYS AND CONCLUSIONS

8.1 Key takeaways

- **Impact of WOWs on workflow and patient safety:**
    - Evidence from published studies and hospital experience suggests that mobile nursing workstations (WOWs) can improve the timeliness of electronic documentation compared to documentation at nurse stations, enabling more real-time charting at the point of care.
    - No direct evidence was found linking WOW adoption to improved patient safety outcomes, but it is hypothesized that observed gains in workflow and documentation timeliness are likely to contribute indirectly to safer, more efficient, and patient-centred care. Direct evaluations of these outcomes are needed.
- **Nurse perception:**
    - Nurses value the mobility, accessibility, and usefulness for medication administration and quick documentation of tasks.
    - While WOWs support workflow efficiency, nurses consistently emphasize the importance of having flexibility in documentation location, using bedside devices for structured entries (e.g., vital signs) and stationary computers for narrative or complex documentation.
- **Design and implementation factors:**
    - The successful adoption and long-term sustainability of mobile nursing workstations (WOWs) depend on thoughtful attention to key design, ergonomics, and local implementation factors.
    - **Ergonomics,** including cart size, stability, noise level, and workspace layout, were repeatedly raised as issues directly influencing nurses' comfort, mobility, and willingness to use WOWs consistently, thereby affecting documentation timeliness and patient safety.
    - **Utility for medication administration:** WOWs equipped with medication cabinets and barcode scanners were particularly appreciated by nurses as a means to reduce medication errors, but qualitative studies have

highlighted the challenges of wheeling bulky carts into narrow patient rooms, a key implementation challenge.

- **Change management:** Successful integration into existing clinical workflows is dependent on the early involvement of nurses in the planning, implementation and evaluation phases to achieve buy-in and align WOW functionality with real-world needs. Training, user testing and feedback mechanisms are needed for continuous improvement.

Together, these factors determine whether WOWs become seamlessly embedded tools that enhance workflow efficiency, data accuracy, and care quality—or remain underused technologies that add burden to clinical practice.

8.2 Conclusions

- Mobile nursing workstations represent a useful enabling technology within the MUHC's broader digital transformation strategy and the ENACT program to enhance nursing efficiency and care quality.
- The current evidence suggests that, when ergonomically designed and well integrated into hospital IT systems, WOWs may reduce documentation delays, streamline workflows, and improve nursing satisfaction.
- However, these advantages are not guaranteed by mobility alone; successful adoption requires attention to ergonomics, ease of technology integration into current workflows, and existing documentation culture. Training, user testing and engagement, and ongoing performance monitoring are critical to ensuring that WOWs add value to clinical practice without compromising patient interaction or safety.
- As part of the ENACT rollout, implementing pilot evaluations with clear performance indicators, including workflow efficiency, technology usability, and infection rates, will help guide sustainable scaling and continuous improvement across MUHC sites.

9. BEST PRACTICE RECOMMENDATIONS

1. Prioritize ergonomic and workflow-centred design:

Experiential evidence indicates that ergonomically-designed WOWs that are well integrated into hospital IT systems may reduce documentation delays and

streamline workflows. Nonetheless, mobility alone does not guarantee benefit; successful adoption requires attention to ergonomics, ease of technology integration into current workflows, and existing documentation culture. There is also a need to evaluate whether outside-the-room WOW carts offer the same point-of-care documentation benefits as beside WOWs.

2. Engage end users and support change management:

Successful integration into existing clinical workflows, particularly medication administration and bedside documentation, requires early involvement of nurses in design selection, piloting, and evaluation to align WOW functionality with real-world needs. Comprehensive education, user testing and engagement, and feedback mechanisms are needed for continuous improvement.

3. Implement continuous evaluation and quality monitoring:

Establish clear performance indicators, such as workflow efficiency, usability, and staff satisfaction, to guide ongoing optimization. Regularly reassess ergonomics, maintenance, and infection control to ensure WOWs continue to enhance documentation timeliness, safety, and patient-centred care.

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APPENDICES

APPENDIX A: CHARACTERISTICS OF INCLUDED STUDIES

Table A-1: Characteristics of included studies according to outcome

Study	Setting	Methods	Modalities compared	Results	Barriers to implementation
Documentation timeliness					
Medero J, Phillips J, Vondracek H. Assessing Differences in Documentation Timeliness of Nurses by Location of Documentation Devices. MEDSURG Nursing 2023;32:292.	3 inpatient nursing units at a 210-bed Midwest suburban community hospital	Retrospective chart review of documentation timeliness	• Stationary computers at the nurses' station • Wall-mounted computers in the patient room • WOWs	**Location of documentation:** Of 317 charts reviewed, documentation occurred at: • Bedside computer: 116 cases (36%) • Nursing station: 173 cases (54%) • WOWs: 29 cases (9%) **Documentation timeliness:** Mean delay: • Bedside computer: 65 mins • Nursing station: 134 min • WOWs: 55 min No significant overall difference (p = 0.097) "Timely" (documentation within 60 min) entries: • Bedside computer: 68% • Nursing station: 43% • WOWs: 59%	• Healthcare leaders typically design documentation flowsheets in collaboration with EHR vendors, highlighting the need for evidence-based approaches to ensure that flowsheets support high-quality documentation and align with nursing workflows.
Carlson E, Catrambone C, Oder K, et al. Point-of-care technology supports bedside documentation. J Nurs Adm 2010;40:360-5.	Six 37-bed medical-surgical clinical units	EHR log analysis (41 286 entries / 7 days, 6 units)	•Stationary computers at the nurses' station • WOWs	With 41,286 data points collected over 7 days: "Timely" (documentation within 60 min) entries: • Nursing station: 57% • WOWs: 72% Statistically significant (p<0.001)	• Competition for devices arises when limited workstations must be shared by nurses and physicians, leading to access bottlenecks during overlapping high-use periods such as medication rounds and vital sign documentation. • Documentation is often interrupted by urgent patient care needs, preventing nurses from completing charting in real time and sometimes

Study	Setting	Methods	Modalities compared	Results	Barriers to implementation
					delaying it until the end of the shift.
Wager, K. A., Schaffner, M. J., Foulois, B., Swanson Kazley, A., Parker, C., & Walo, H. (2010). Comparison of the quality and timeliness of vital signs data using three different data-entry devices. *Computers, informatics, nursing : CIN*, *28*(4), 205–212.	Four adult inpatient medical/surgical units at a level I trauma hospital with 709 beds	Direct observation of patient care technicians collecting vitals signs	• Paper medical record system • WOWs outside patient room: handwritten vital signs on paper transcribed to computer on wheels • Tablet PC affixed to mobile vital signs monitor in patient's room	**Accuracy:** Of 270 observations, documentation error rate: • Bedside mobile computer: 5.6% • WOWs: 15.2% • Paper documentation: 16.8% **Documentation timeliness:** Mean delay to chart vital signs: • Bedside mobile computer: 35sec • WOWs: 9min15sec • Paper documentation: 1min24sec	• Insufficient space to easily wheel the computer workstations (with medication drawers) into the patient's room • Resulted in handwritten vitals signs later transcribed to WOWs • WOWs outside patient room often occupied by nurses and other clinicians, leading to documentation occurring after rounding.
Nurse Perception of Utility					
Gauthier-Wetzel, H. (2024). Bedside Nurse Documentation Practices. *CIN: Computers, Informatics, Nursing, 42* (9), 629-635. doi: 10.1097/CIN.0000000000001165.		Qualitative interviews of 30 nurses before and after moving from WOWs to wall-mounted in-room computers	• Wall-mounted computers in the patient room • WOWs	**Pros of WOWs:** • Nurses preferred WOWs for mobility, large screens and medication administration. **Con of WOWs:** • Tends to congest hallways, block pathways, • Requires reliable charging solutions **Pros of wall-mounted PCs:** • Ease and accuracy of assessments at bedside • Best for quick notes with more detailed charting at nurse station **Con of wall-mounted PCs:** • Wall-mounted PCs viewed as disruptive at night • Time-inefficient due to wait for PC boot up and interruptions from family members • Desired flexibility to choose location based on task.	

Study	Setting	Methods	Modalities compared	Results	Barriers to implementation
Graham HL, Nussdorfer D, Beal R. Nurse Attitudes Related to Accepting Electronic Health Records and Bedside Documentation. Comput Inform Nurs 2018;36:515-20.	All nursing departments within 2 hospitals where nurses were provided with WOWs	Descriptive narrative qualitative study of 8 nurses	• WOWs	**Competing priorities:** • Bedside documentation was often deprioritized due to other patient care duties and was seen as taking time away from direct patient interaction. • Medication administration at the bedside was viewed as the main patient-safety benefit. • Some nurses felt bedside documentation served administrative metrics more than patient care, and few saw EHR decision support as enhancing evidence-based practice. **Balancing technology and patient care:** • Nurses worried that documenting on computers distracted from patient engagement, though it enabled quick access to patient information. • Several noted the potential for a "nurse–patient–machine" triad partnership to support care. **Adoption challenges:** • Nurses described tension between expectations for efficiency and the added time and redundancy of electronic bedside documentation, emphasizing the need for practice and adaptation.	• Highlights need for training and cultural adaptation to integrate technology without eroding patient rapport.
Medero J, Phillips J, Vondracek H. Assessing Differences in Documentation Timeliness of Nurses by Location of Documentation Devices. MEDSURG Nursing 2023;32:292.	3 inpatient nursing units at a 210-bed Midwest suburban community hospital.	Nurse interviews (n=25) for location preference	• Stationary computers at the nurses' station • Wall-mounted computers in the patient room • WOWs	**Barriers to documentation at specific locations:** • 80% of nurses cited patient interruptions as the main barrier to bedside documentation. • 88% of nurses identified staff interruptions as the most prevalent barrier to documentation at the nurses' station. **Context-specific documentation:** • Nurses preferred completing required documentation, such as vital signs (72%, n=18), pain assessment (64%, n=16), and admission documentation (92%, n=23), at the bedside. • They preferred documenting other patient assessments,	

Study	Setting	Methods	Modalities compared	Results	Barriers to implementation
				such as venous thromboembolism assessment (96%, n=24), patient education (100%, n=25), and the plan of care (100%, n=25), at the nurses' station.	
Carlson E, Catrambone C, Oder K, et al. Point-of-care technology supports bedside documentation. J Nurs Adm 2010;40:360-5.	Six 37-bed medical-surgical clinical units	Survey of nurses (n=11)	•Stationary computers at the nurses' station • WOWs	• Nurses preferred stationary PCs for longer charting sessions • WOWs were preferred for medication administration due to their mobility and built-in shelves. • Nurses identified several drawbacks of WOWs such as bulkiness, short battery life, poor manoeuvrability, and inconsistent connectivity.	