GE Healthcare

Study report

Evaluating the Impact of CARESCAPE™ ONE as a Patient Transport Monitor in Care Settings

CONTEXT ON PATIENT TRANSPORT MONITORING

Patient transport has evolved into a major activity in healthcare with significant resource implications for healthcare providers. Today's intra-hospital patient transport has become an important part of healthcare delivery. It is a complex and highly sensitive process that requires adherence to high quality and safety standards. It is also a time-consuming task for nurses working in critical care areas, often resulting in nurses performing various tasks with higher physical and psychological requirements. Since these tasks can raise the level of stress and fatigue, nurses often tend to experience a higher workload and fatigue level[1]. Furthermore, a study published in 2015 in Nursing Critical Care indicates that increased workload among critical care nurses in ICU often keeps them from taking necessary work breaks[2], adding more to the existing levels of work stress. As such, patient transport often contributes to higher stress levels for staff, as indicated by a comprehensive study conducted by the American Nurses Association, which reports that 82%[3] of nursing staff are at a "significant level of risk for workplace stress," and that stress impacts staff productivity. Stress-related productivity issues could result in underutilization of valuable resources, causing a "domino effect" and creating operational inefficiencies for the healthcare facility. Therefore, healthcare facilities have been seeking a more efficient and better featured transport monitor that could ensure relative ease of use while enabling faster and safer patient transport.

ABSTRACT

Objective: A comparative usability study was conducted to assess the workflow impact and evaluate productivity gains during active patient transport using the CARESCAPE ONE advanced patient transport monitoring solution from GE Healthcare, as compared with a patient transport monitor of similar class.

Methodology: The comparative usability study was conducted in a state-of-the-art simulation center where patient transport was simulated using transport nurses. Qualitative information and quantitative data was collected using survey tools, measuring start-to-end transport time, user errors during performance of tasks, and time to clean the respective monitors.

Results: In the comparative usability (time and motion) study, the participants expressed strong preference for the CARESCAPE ONE monitor over the other transport monitor device tested. The study shows a statistically significant increase in workflow productivity and highlights greater ease of use associated with CARESCAPE ONE as a patient transport monitor. Users indicated that CARESCAPE ONE required a lower mental workload, Specifically, the study found that participants using the CARECAPE ONE monitor experienced:

- Overall 26% less patient transport time, and
- 60% fewer user errors in performing routine transport tasks.
- 17% less workload stress.

67% of participants believed that the CARESCAPE ONE monitor was more robust to work with and could be handled easily due to better ergonomic design. In addition, 88% of participants preferred CARESCAPE ONE over the comparator device as their next-generation transport monitor.

Conclusion: The quantitative and qualitative study results indicate that CARESCAPE ONE can help improve patient transport safety and staff efficiency.

INTRODUCTION

CARESCAPE ONE is an advanced monitoring solution for conducting patient transport. It allows nurses to visually monitor critical patient conditions with precision during active patient transport between care areas. The solution is a portable monitor device with docking capability on the transport bed or at the bedside. It is designed to provide an efficient workflow with the added benefit of relative ease of use for new as well as experienced users. The product includes a user interface designed to enable customization for individual care environments, thus simplifying tasks and reducing errors during patient transport. CARESCAPE ONE features a new design approach, where every host monitor (CARESCAPE ONE) is standardized and externalized measurements (CARESCAPE PARAMETERS) enhance the user experience, allowing greater standardization and improved customization. This helps to streamline workflows and has a positive impact on user productivity.

METHODOLOGY

To evaluate the impact of CARESCAPE ONE, a blinded usability study was conducted, comparing its patient transport and cleaning processes to a comparator device of similar class.

A comparative usability study, supervised by leading simulation experts, was conducted at the Center for Simulation in Health (CESIM) at the Sante Simulation Centre in Brest. France. The study included 25 experienced nurses who had been exposed to different patient transport monitors and specialized in patient transport. They were recruited for a week–long study to compare productivity with the two monitors in terms of time savings, workflow efficiency, and performance-related workload.

The recruitment process was carefully designed to maximize participants' neutrality. To that end, participants with varying experience were interviewed, and participants experienced with only a single brand of patient transport monitor were limited to less than 40% of the group selected, so as to avoid user bias. The results were analyzed retrospectively at an overall level and with respect to each subgroup for the study and with respect to the user groups to minimize any bias while presenting the results.

The devices were tested in a simulated patient transport scenario. Data around product usage and performance was collected using standard data collection tools. The study was comprised of five sections:

Section 1: Standardized video-based training on the devices given to all participants.

Section 2: Tasks related to participants performing simulated patient transport

Section 3: Tasks related to simulated cleaning of the devices at the bedside

Section 4: Capture of quantitative feedback from the participants using established survey tools

Section 5: Interviews with participants to collect qualitative feedback on their overall user experiences.

Training: The participants viewed a training video to learn the functionality of the products associated with key vital tasks. After training, the participants were given an average wait period of at least 10 minutes to enable them to reflect on what they learned before undertaking the simulated tasks.

Task 1: A three-part task involved transport where a patient represented by mannequin was to be transported from a simulated operating room to a simulated ICU. The task included:

- Preparation of the patient for transport, and undocking and docking of the transport monitor from the anesthesia device docking station to the transport bed
- Performing the actual transport
- Completion of transport by transferring the patient to the ICU bed and undocking and docking of transport monitor from transport bed to bedside mount in the ICU.

These tasks included steps that would be necessary to perform during an actual transport. The participants were timed as they performed the series of steps. All three parts of the task were observed and recorded.

Task 2: The participants were timed and evaluated on their efficiency in cleaning the transport monitors at the patient bedside in the ICU. Participants were given clear instructions on how to clean the devices with standard recommended disinfectant wipes used for medical products in hospitals. The task required participants to undock the transport monitor from the central console; unplug the cables; clean the monitor, cables and wires; and dock the monitor and plug the cables back into the central console. Observations were captured in terms of time to complete each task and the accuracy with which each task was performed.

Quantitative Feedback: Data was collected digitally with the help of global and industry accepted tools for performing analysis and quantitative evaluation.

The impact on productivity was evaluated in terms of intra-operative time savings (during preparation for patient transport) and associated workflow efficiency, along with measurement of accuracy in performing key functions. The duration of each simulated patient transport was recorded, identified, qualified, and synchronized for timing with respect to all tasks. The steps performed were then identified individually to evaluate for precise task duration and task completion. The participants performed the respective tasks with each monitoring device; the devices were rotated in sequential order to minimize any bias. A study moderator observed the participants and tracked their performance for tasks completed, skipped tasks, and assistance required in order to measure the level of accuracy in performing each step. The moderator also timed each task in sequential order. After completion of each task, the moderator gathered feedback from the participants with the help of these tools:

- **NASA Task Load Index (NASA TLX) score[4]:** NASA TLX is an established gold standard tool to measure/assess the level of workload and associated mental stress on the user.
- **System Usability Scale (SUS)[5]:** SUS is a standardized metric used to measure the usability of products and users' experience with the products, and to capture users' perceptions of the system around key attributes such as effectiveness[6], efficiency[7] and satisfaction[8].
- **User Experience (UXS/UQE):** The UXS survey questionnaire is designed to capture a comprehensive impression of users' experience on products or systems around key attributes such as learnability, usefulness, desirability and efficiency.
- **Net Promoter Score (NPS)[9]:** NPS is means to measure users' overall satisfaction with a product and their perceived loyalty toward the product. The survey asks how likely the respondents would be to recommend the product to other professionals in positions similar to their own.
- **Likert Scale Analysis[10]:** This tool captures users' level of agreement/disagreement on specific product attributes with the help of a five-point rating scale. User are asked to respond to nine specific statements associated with the product.

Qualitative Feedback: The participants were interviewed face-to-face to gather qualitative feedback on the different aspects of simulated patient transport and their interactions with the device during the transport. The interviews covered areas such as transport, cleaning. and device functionality.

RESULTS SUMMARY

Comprehensive analysis of the data resulted in overall participant preference for the CARESCAPE ONE monitor.

Detailed analysis of user feedback data revealed that CARESCAPE ONE outperformed the comparator product in terms of greater user effectiveness and improved user performance; The observations, when analyzed statistically, indicated that users performing tasks with CARESCAPE ONE:

- Were able to complete the required tasks for patient transport efficiently contributing to greater user effectiveness due to better user experience with the device (further explained under the user survey results section)
- Experienced improved performance resulting in a significant reduction in time (patient preparation for transport, transport duration, and completion of transport) and improvement in overall workflow. This was due to the reduction in associated workload and stress to complete tasks as per the NASA TLX survey results (further explanation provided under the user survey results section)

Results from the transport-related tasks as captured by the observer and recorded for further analysis indicated that CARESCAPEONE delivered advantages as shown in Figures 1-4 below and explained later in detail.

Figure 1

Figure 2

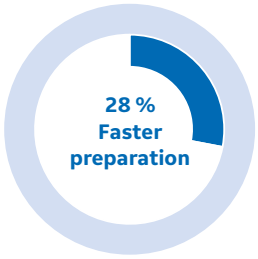


Figure 3

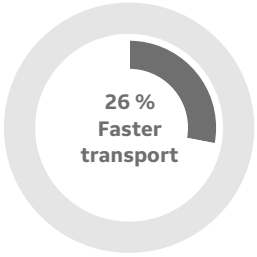
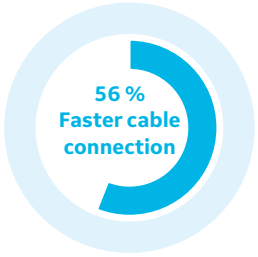
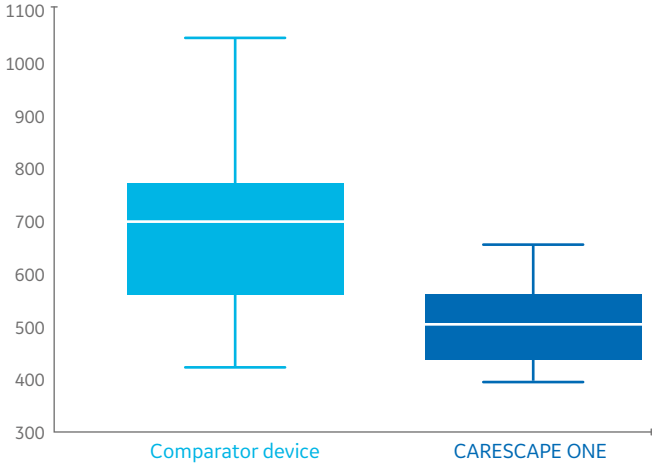


Figure 4



Overall Faster Transport time: The detailed analysis indicated that **with CARESCAPE ONE. overall patient transport was 26% faster** than with the comparator system.

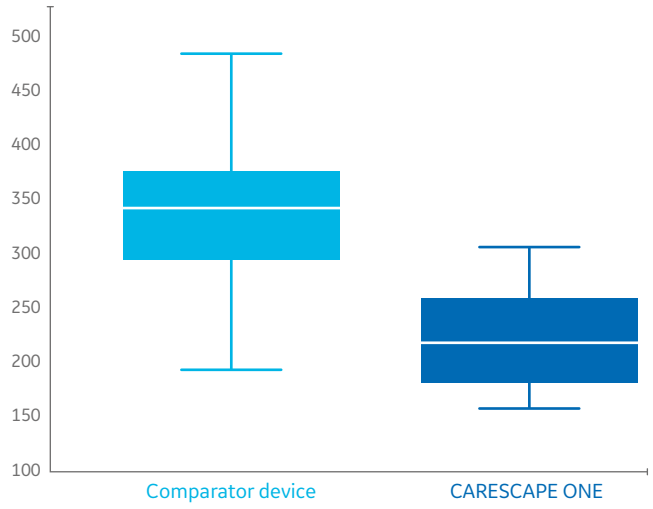
Figure 5: *Overall patient transport time*



Comparator system *694 ± 196 vs.*
GE CARESCAPE ONE *514 ± 156 (in seconds) P=0.003*

Faster preparation time: A detailed analysis of the overall transport time indicated **that with CARESCAPE ONE, transport preparation time was 28% faster** than with the comparator system.

Figure 6: *Transport Preparation time*



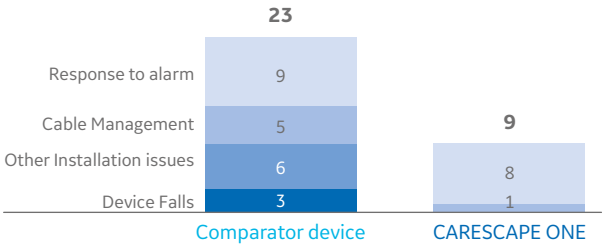
Comparator system *366 ± 113 vs.*
CARESCAPE ONE *242 ± 77 (in seconds) P=0.0001*

The major benefit with CARESCAPE ONE was observed with its cable connection (CARESCAPE ONE: 8 seconds ± 7 seconds versus the comparator system: 33 seconds ± 46 seconds). Participants were able to achieve a significantly shorter monitor docking time with CARESCAPE ONE which stood at 5 seconds ± 12 seconds where as participants with comparator system took 50 seconds ± 39 seconds; this significant time savings also positively impacted the participants overall transport time and performance.

Participants with CARESCAPE ONE completed the overall transport from the OR to the ICU relatively faster than with comparator device. GE CARESCAPE ONE: 514 seconds ± 196 seconds versus the Comparator system: 694 seconds ± 196 seconds.

Reduced Task Error rate: A retrospective analysis of the recording of the observations was made on task time and the accuracy of tasks performed. Of the total 225 tasks performed, participants performed the tasks with greater ease and with significantly fewer errors when using CARESCAPE ONE. Participants also indicated that the bulkiness of the comparator system led to trips and falls on three occasions while handling the device during transport preparation.

Figure 7: *Distribution of user tasks error*



Study observation recorded a total of 23 errors with comparator system. including three falls, vs. nine errors with CARESCAPE ONE; with P value p=0.017

Detailed analysis of task completion and accuracy indicated that **participants working with CARESCAPE ONE were up to 60% less susceptible to errors during active transport versus the comparator device**. Participants believed that CARECSAPE ONE might have a positive impact in reducing service costs associated with device falls and broken parts, alongside the efficiency gain due to workflow improvements.

USER SURVEYS

Data was collected from the different tools for analyzing participants' responses for utility, ease of use, performance stress, and overall user satisfaction. After completion of Task 1 (simulated patient transport) and Task 2 (simulated cleaning), participants were surveyed with the NASA TLX tool to assess the subjective mental and temporal workload.

CARESCAPE ONE was less stressful to work with and required less effort: Overall analysis of NASA TLX scoring system indicated that CARESCAPE ONE required less mental and physical workload than comparator product (17% reduction in workload scoring). The survey revealed that CARESCAPE ONE required lower global mental workload, especially regarding physical and temporal demands.

Device during Transport: 70% of participants indicated CARESCAPE ONE required less physical demand: as much as 31% less physical strain (activity) and 33% less associated pressure to complete the tasks. Detailed analysis also revealed that participants needed up to 20% less effort when working with CARESCAPE ONE.

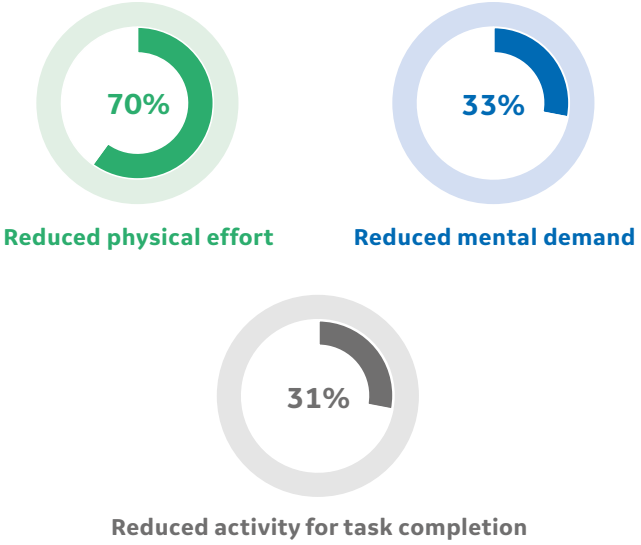
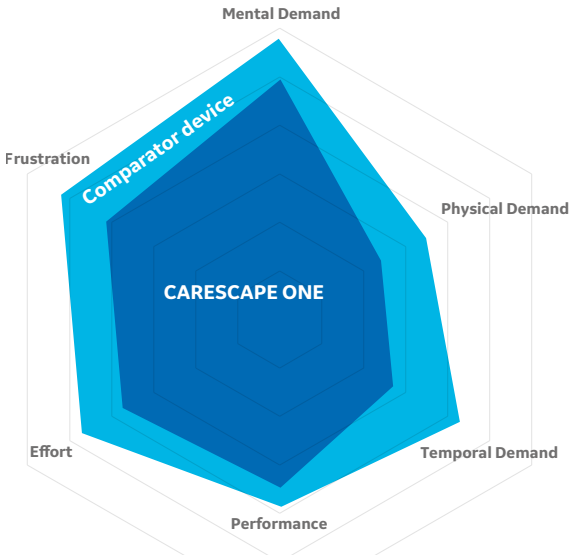


Figure 8: *Task work load representation to perform patient transport with the respective transport monitor devices*



Comparator system *49.9 ± 20.9 vs.*
CARESCAPE ONE *41.2 ± 18.7; P = 0.14 (ns)*

Graphical representation of distribution of physical, mental and temporal demand to perform patient transport with CARESCAPE ONE and comparator devices

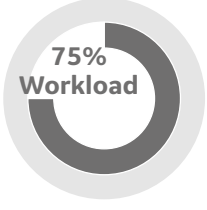
Larger chart area represents greater value/Reference to the values: The lower the value, the easier to use is the device

CLEANING OF DEVICE

When subjected to NASA TLX and other tools for feedback on cleaning of the device, CARESCAPE ONE users indicated up to 55% less effort required. Participants also noted up to 40 % lower physical and workload demand.

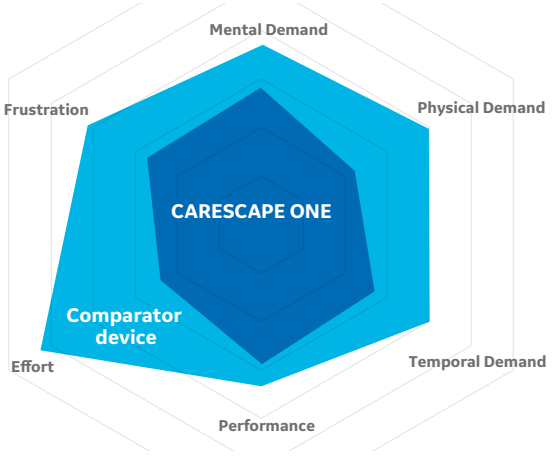
Easy to clean

Faster to clean



Reduced cleaning workload

Figure 9: *Task workload representation to perform cleaning of the respective transport monitor devices*



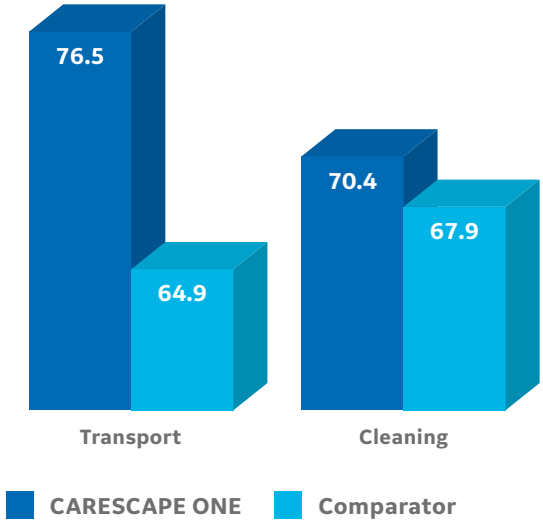
Comparator system *22.3 ± 24.2 vs.*
CARESCAPE ONE *14.6 ± 9.9; P = 0.16 (ns)*

Graphical representation of distribution of physical, mental and temporal demand to perform cleaning of patient transport with CARESCAPE ONE and comparator devices

SYSTEM USABILITY SCALE

The CARESCAPE ONE achieved a higher usability rating, with a SUS score of **76.5 for patient transport and 70.4 for cleaning**, versus scores of 64.9 to 67.9 for the comparator device. The benchmark range is based on the SUS database of 500 studies. A score above 68 is considered above average, and anything below 68 is below average[11].

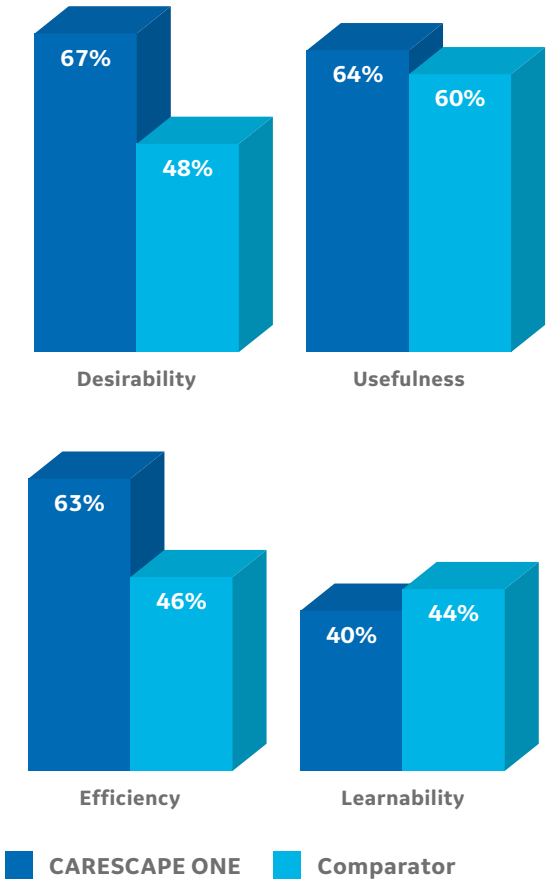
Figure10: *System Usability Scale*



USER EXPERIENCE EVALUATION
Each participant completed a User Experience Questionnaire evaluating the devices on four standard scales of usability. The questions were asked on a bipolar semantic scale; scoring was on a -3 (extremely bad) to +3 (extremely good) scale. The scores were combined to form composite scores pertaining to:

- **Desirability:** Overall impression of the product; Do users like or dislike it?
- **Usefulness:** Is it easy to get familiar with and learn how to use the product?
- **Efficiency:** Can users do their tasks without unnecessary effort? Does the product react fast?
- **Learnability:** Do users feel in control of the interaction? Is it secure and predictable?

Figure11: *Results from User Experience Questionnaire*

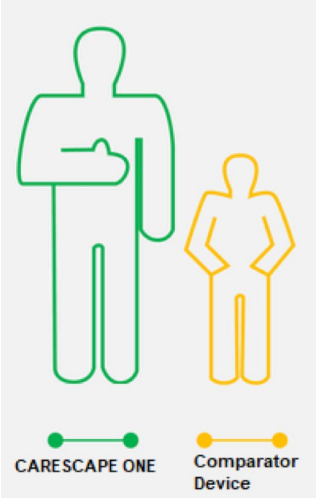


CARESCAPE ONE in comparison with the comparator product was rated higher range on three out of four metrics of the User Experience Questionnaire. This, demonstrates higher perceived usability for CARESCAPE ONE over comparator product; participants rated CARESCAPE ONE with considerably higher efficiency and desirability (preference).

The above charts indicate the following:

- Users' perceived the GE unit to be more efficient than the comparator
- GE CARESCAPE ONE gained more acceptance and was perceived as more desirable for the users.

Please note: The above results indicate feedback from all 25 participants. 36% indicated that they had previous working experience with the comparator device in the past; this might have impacted the learnability scores. A separate comparative analysis of participants' ratings revealed that CARESCAPE ONE learnability scores fared better and were 24% higher when participants with comparator experience were eliminated from the data set.



Net Promoter Score: Study participants were asked how likely they would be to recommend each system to their colleagues, on a scale of 0-10. Responses of 9-10 are promoters, 7-8 are passives, and 0-6 are detractors.

8 participants out of 10 preferred to recommend CARESCAPE ONE to others. 88% of users from the study also agreed that they would select CARESCAPE ONE instead of the comparator product as their next-generation transport monitoring solution. They also perceived that CARESCAPE ONE would have clinical and operational benefits to their daily transports.

LIKERT SCALE / COMPARATIVE RATING EVALUATION
Participants rated the systems on an Agree/Disagree Likert scale on a series of statements related to quality, efficiency, and ease of use. CARESCAPE ONE had the highest percentage of respondents strongly agreeing or agreeing with each statement excluding alarm setting due to a larger touch button on the comparator device (Table 1 and Table 2).

CARESCAPE ONE also had 100% of respondents strongly agreeing that the product's design made it easier to use and faster to clean. 88% percent of the participants strongly agreed or agreed that the CARESCAPE ONE cable plugging system was easy to use and had a positive impact on workload stress versus the comparator device. Up to 93% of

participants agreed that CARESCAPE ONE features such as touch screen sensitivity and better ergonomic design significantly contributed to better workflow optimization over the comparator device. With respect to alarm settings, the participants favored the comparator device due to a larger touch button, which allowed them to adjust the alarm settings with some degree of ease.

DISCUSSION

The participants in the study were selected to give a range of experience of using patient transport monitors and this included some users that had experience with the comparator device. Detailed sub-group analysis of the UXS scores excluding users that had prior experience with the comparator device revealed that CARESCAPE ONE in a direct comparison with comparator device outperformed the comparator device in every aspect. In particular, this subgroup data analysis (excluding users with prior experience of the comparator device) revealed that CARESCAPE ONE was 24% easier to learn and familiarize when directly compared with comparator device. This suggests that in the overall user dataset that the higher learnability scores for the comparator device might have been due to participants previous user experience and familiarity with the comparator device. Thus to represent the real world situation, where transport monitor users are likely to have varied experience with different devices, results are shown from all participants and further participant subgroup analysis was not performed.

CONCLUSION

This evaluation of the CARESCAPE ONE transport monitoring solution and its impact on user workflow as compared to the comparator device clearly demonstrated the potential for significant benefits from the CARESCAPE ONE device for healthcare organizations, staff and patients.

The CARESCAPE ONE monitoring platform reduced the time required to prepare patients for transport as well as the total transport time versus a comparative device of the same class.

The study also demonstrated that CARECSAPE ONE decreased the number of user errors due to a better ergonomics, higher ease of use, and a greater user confidence.

The quantitative and qualitative study results explained above indicate that CARESCAPE ONE may help improve patient transport safety and staff efficiency. Users have recognized CARESCAPE ONE as a preferred solution for patient transport monitoring with 88% of participants choosing CARESCAPE ONE as their preferred choice of a patient transport monitoring device. They indicated that the device can possibly help realize potential benefits as a long-term and viable solution to protect investments.

Table 1. *Overall feedback from all participants including users with comparator device experience*

Key Questions	Value mean	CARESCAPE ONE	Comparator
Monitor design makes it faster and easier to clean / use	4.6 ± 0.1	100%	63%
Overall, general system cleaning is easy	4.5 ± 0.1	100%	80%
Monitor design allows you to clean faster	4.4 ± 0.1	100%	60%
Touchscreen is sensitive enough	4.3 ± 0.1	96%	92%
Touchscreen sensitivity makes it rapid to use	4.4 ± 0.2	93%	77%
Cables plugging, and unplugging capabilities decreases workload	4.2 ± 0.2	88%	46%
I would like to use this device	4.0 ± 0.2	84%	67%
This device improves workflow and decreases transport time	4.4 ± 0.2	80%	54%
Touchscreen is easy to use	4.4 ± 0.2	79%	75%
This device is easy to use	4.0 ± 0.2	76%	74%
Device's capabilities make it easy and rapid to use	3.8 ± 0.2	75%	71%
This device decreases the number of required tasks required to monitor patients	3.5 ± 0.2	54%	50%
Did you experience difficulty to change the alarm settings	3.2 ± 0.3	50%	18%

Table 2. *Survey feedback from user with no prior experience with transport monitor used in the study*

Key Questions	Value mean	CARESCAPE ONE	Comparator
Monitor design makes it faster and easier to clean / use	4.5 ± 0.1	100%	63%
Overall, general system cleaning is easy	4.6 ± 0.1	100%	80%
Monitor design allows you to clean faster	4.5 ± 0.2	100%	60%
Touchscreen is sensitive enough	4.2 ± 0.2	93%	86%
Touchscreen sensitivity makes it rapid to use	4.3 ± 0.2	89%	63%
Cables plugging, and unplugging capabilities decreases workload	4.1 ± 0.3	86%	50%
I would like to use this device	4.1 ± 0.2	87%	57%
This device improves workflow and decreases transport time	4.3 ± 0.2	89%	25%
Touchscreen is easy to use	4.3 ± 0.2	79%	64%
This device is easy to use	4.1 ± 0.2	80%	62%
Device's capabilities make it easy and rapid to use	3.6 ± 0.2	64%	64%
This device decreases the number of required tasks required to monitor patients	3.6 ± 0.3	57%	50%
Did you experience difficulty to change the alarm settings	2.8 ± 0.4	46%	15%

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2. Ringdal M, Chaboyer W, Warrén Stomberg M. Intrahospital transports of critically ill patients: critical care nurses' perceptions. *Nurs Crit Care. 2016 May;21(3):178-84. doi: 10.1111/nicc.12229. Epub 2015 Dec 29.*
3. American Nurses Association Health Risk Appraisal Findings; Executive Summary. Key findings October 2013 - October 2016
4. NASA Task Load Index (TLX): NASA TLX is a global Gold Standard tool which is widely used to measure subjective, multidimensional workload assessment tool that rates perceived workload to assess a task, system and user effectiveness or aspect of performance when working with various human-machine interface systems
5. System Usability Scale (SUS): is one of the best known standardized usability rating scales. It focuses on capturing subjective feedback from users with the help of ten standardized questionnaire. The SUS was developed by John Brooke (DEC) in 1986.
6. Effectiveness - can users successfully achieve their objectives while using the product
7. Effort - how much effort and resource is expended in achieving those objectives when working / engaging with the product
8. Satisfaction - was the experience with the product satisfactory
9. Net Promoter Score (NPS) questions that was created by Fred Reicheld and Bain & Company. NPS is an index ranging from -100 to 100 that measures the willingness of customers to recommend a company's products or services to others.
10. Likert Scale Analysis: Developed in 1932 by Rensis Likert to measure attitudes, the typical Likert scale is a 5- or 7-point ordinal scale used by respondents to rate the degree to which they agree or disagree with a statement
11. Sauro, Jeff. Measuring Usability with the System Usability Scale. February 2, 2011

Imagination at work

JB61353XX(2) 12/18

CARESCAPE ONE is a CE marked medical device.