# Patient attitudes towards remote continuous vital signs monitoring on general surgery wards: An interview study

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**Category:** Qualitative interview study

**Originality:**

This article is an original work, has not been published before, and is not being considered for publication elsewhere in its final form, in either printed or electronic media. It is not based on any previous communication to a society or meeting.

**Keywords**

Vital signs, monitoring, early warning scores, interviews, patient experience

**Word count:** 3,227 words

**Abstract**

*Background*

Vital signs monitoring is used to identify deteriorating patients in hospital. The most common tool for vital signs monitoring is an early warning score, although emerging technologies allow for remote, continuous patient monitoring. A number of reviews have examined the impact of continuous monitoring on patient outcomes, but little is known about the patient experience. This study aims to discover what patients think of monitoring in hospital, with a particular emphasis on intermittent early warning scores versus remote continuous monitoring, in order to inform future implementations of continuous monitoring technology.

*Methods*

Semi-structured interviews were undertaken with 12 surgical inpatients as part of a study testing a remote continuous monitoring device. All patients were monitored with both an early warning score and the new device. Interviews were audio-recorded, transcribed verbatim and analysed using thematic analysis.

*Findings*

Patients can see the value in remote, continuous monitoring, particularly overnight. However, patients appreciate the face-to-face aspect of early warning score monitoring as it allows for reassurance, social interaction, and gives them further opportunity to ask questions about their medical care.

*Conclusion*

Early warning score systems are widely used to facilitate detection of the deteriorating patient. Continuous monitoring technologies may provide added reassurance. However, patients value personal contact with their healthcare professionals and remote monitoring should not replace this. We suggest that remote monitoring is best introduced in a phased manner, and initially as an adjunct to usual care, with careful consideration of the patient experience throughout.

## 1. Introduction

Patients undergoing major surgery are at high risk of potentially life-threatening complications. Rates of serious complications have been found to be as high as 33-44% (1). Early recognition of postoperative complications is crucial in reducing morbidity and preventing long term disability(2).

One way patients are monitored for complications is by recording on a chart their vital signs: blood pressure, heart rate, breathing rate and temperature. The vital signs are used to form an early warning score (EWS), which can alert if the patient becomes unwell. However, EWS systems are limited by their intermittent and user-dependent nature. Emerging technologies allow for remote, continuous patient vital signs monitoring. A number of reviews have examined the impact of continuous monitoring on patient outcomes(3), but little is known about the patient experience of vital signs monitoring.

### *1.1 Early warning scores*

EWSs have been widely adopted throughout the UK and other Western countries, and different versions exist. A number of studies have shown that EWSs can also be used in countries with limited healthcare resources, such as Uganda(4,5), Tanzania(6,7) and South Africa(8–10).

Although EWS systems have proven benefit, they suffer from several drawbacks. EWSs rely on manual observation rounds, are time-consuming, and are open to user interpretation and errors in calculation.

Both the National Institute for Health and Clinical Excellence (NICE) (11) and the review of current practice in the Mid Staffordshire NHS Foundation Trust(12) recommend use of electronic observations systems to counteract some of these limitations. Vital signs are measured and entered manually into a mobile device, typically a tablet computer. All data are transmitted immediately to a central server and the system detects impossible readings and omissions, automatically calculates the EWS and provides clinical advice based the result. Electronic observations may also reduce the workload of paper-based EWS systems (13,14) although study results are mixed(15).

Electronic observations do not overcome one of the primary failings of the EWS system: the gap between observations(16). Typically, for surgical patients, the EWS will be calculated half hourly for the first few hours after surgery. If the patient remains stable, the frequency will decrease to 2-hourly and then 4-hourly, until the patient is ready for discharge when the EWS may be recorded only twice a day.

Patient deterioration is possible between recordings. A solution to the problem of inadequate monitoring frequency is continuous monitoring at the bedside.

### *1.2 Continuous vital signs monitoring*

Until recently, continuous vital signs monitoring was limited to intensive care units (ICUs) because it required high staff-to-patient ratios and cumbersome equipment which tethered the patient to the bed-space, thereby inhibiting patient mobility and

recovery. When ICU-style monitoring was implemented on a general ward, only 16% of patients remained connected in a 72-hour period(17).

However, minimally-intrusive remote monitoring technologies, aided by wireless data transmission, have the potential to convey the advantages of continuous, ICU-style vital signs monitoring to general wards. One such device is the SensiumVitals® patch. This small, wireless patch is worn on the patient's chest and monitors heart rate, respiratory rate and temperature continuously. The data is transmitted wirelessly every two minutes to a mobile device carried by the nurse. This alerts the nurse when there is deviation from pre-set physiological norms, alerting them to potential patient deterioration.

It is hypothesised that continuous vital signs monitoring may allow earlier detection of patient deterioration and thereby improve patient outcomes. However, the small number of quantitative studies in this area show mixed results(3). It is possible that the success of these technologies is context-dependent, and reliant on effective engagement with the technology by both patient and practitioner.

A review of the literature has identified five studies which report nursing perceptions of continuous monitoring systems (18–22) and all identified similar themes. Nursing staff could see the potential for continuous monitoring to enhance patient safety. Nurses perceived that greater 'availability and accessibility' of vital signs information would support their decision-making and provide reassurance to patients(20). Interestingly, Jeskey *et al.* found a more positive perception in nurses looking after higher-acuity patients, such as those just back from surgery(21).

Prgomet *et al.* reported concerns from both doctors and nurses about over-reliance on continuous monitoring leading to decreased bedside interactions(20). Alternatively, some nurses were worried that visibility of information and alarms would cause patient anxiety, leading to increased time spent to reassure them. However, the visibility of information on continuous monitoring devices were also considered to provide opportunities for increased engagement of patients in their own care.

Only one study was found that included patient satisfaction as an *a priori* outcome measure(22). Out of 25 patients surveyed, 22 felt positively about continuous monitoring because it gave them a sense of 'security,' whilst other patients found the monitors to be restrictive or uncomfortable. The results of this study are limited by the small sample size and the patient selection criteria, but highlight the importance of considering the patient's experience of continuous monitoring.

In this paper, we report a qualitative study involving semi-structured interviews with patients. The aim of this study was to investigate patient perceptions of current monitoring practices and the introduction of continuous monitoring devices on general surgical wards, in order to inform future implementations of this technology.

## 2. Methods

### *2.1 Study design*

Semi-structured interviews were performed with patients participating in a randomised controlled study evaluating the SensiumVitals® remote continuous monitoring device (the “patch”) on two surgical wards at a single large teaching hospital in England. Patients who were randomised to the patch arm of the study received continuous remote vital signs monitoring for the duration of their hospital stay, in addition to standard intermittent EWS monitoring. These patients were compared to those receiving intermittent EWS monitoring alone.

The purpose of these interviews was to glean information about patient experiences of their vital signs monitoring whilst in hospital, with particular emphasis on their experiences of intermittent EWS monitoring and the continuous remote monitoring device.

### *2.2 Data collection*

Participants were recruited using purposive sampling from those patients who were randomised to the patch arm of the study. We aimed to interview a range of patients across both wards, including both sexes, different ages and different durations of monitoring.

Interviews were conducted over a 6-week period, face-to-face, at the patient’s hospital bedside. The interviewer used a pre-determined topic guide, informed by *a priori* theories developed by CD through informal interactions with patients and ward staff during the day-to-day management of the randomised controlled study. However, data collection was an iterative process and, as recurring concepts emerged, these were added to the interview guide for exploration with remaining participants. All interviews were audio recorded.

Interviewing stopped when data saturation was reached. Interviews were transcribed verbatim and anonymised. The interview transcripts were then entered into the software package NVivo 10 for organising and analysing the data.

Research Ethics Committee approval was obtained for this study (REC reference 16/YH/04/26) and written consent was gained from patients.

### *2.3 Analysis*

Transcripts were analysed using Braun and Clarke’s thematic analysis(23). First, the data were analysed by reading and searching the transcripts for common attitudes and experiences between participants. Emergent themes were coded, and the codes applied line-by-line to the transcripts by CD. The data were then systematically reviewed to ensure the themes worked in relation to the coded extracts. Codes were then independently verified by RR. Any discrepancies in application of codes to the transcripts were discussed until agreement was reached by CD and RR.

## **3. Findings**

Twelve patients consented to be interviewed (see Table 1). Six patients were male; 6 patients were female. Their ages ranged from 42 to 83 years. The number of days spent in hospital at the time of interview ranged from 5 to 27 days, and the number of days spent wearing the patch at the time of interview was between 1 and 15 days.

| Patient | Sex | Age | Number of days spent in hospital* | Number of days spent wearing the patch* |
|---|---|---|---|---|
| 1 | Male | 42 | 5 | 1 |
| 2 | Female | 73 | 9 | 8 |
| 3 | Male | 83 | 27 | 15 |
| 4 | Female | 82 | 13 | 9 |
| 5 | Male | 73 | 13 | 9 |
| 6 | Male | 63 | 11 | 2 |
| 7 | Female | 73 | 11 | 7 |
| 8 | Female | 74 | 22 | 5 |
| 9 | Female | 53 | 8 | 4 |
| 10 | Male | 81 | 7 | 4 |
| 11 | Female | 69 | 9 | 8 |
| 12 | Male | 55 | 7 | 5 |

*at time of interview

Table 1: Demographics of interviewed patients

*3.1 Themes*

Six main themes emerged from the interviews: (i) importance of nursing contact, (ii) night time burden, (iii) comfort, (iv) sense of security, (v) staffing concerns and (vi) trust of technology.

(i) Importance of nursing contact

Overall, patients reported positive experiences of vital signs observation rounds. Patients were keen to emphasise their appreciation of face-to-face nursing contact, and their concerns that remote monitoring might replace this.

> "The only thing that passes my mind as well is, would you do without… that contact with the nurses, if you're going to be using this?" (Patient 1)

Patients were keen to point out that face-to-face contact was necessary in addition to monitoring physiological numbers, as the latter can sometimes be misleading about a patient's state.

> "It gives you readings but it doesn't really tell you how you're feeling. Do you know what I mean? …So you still need your nurses to go round and have a look at the patient. I just hope it doesn't get rid of nurses." (Patient 2)

> "When it comes to nursing, you can never replace that." (Patient 11)

A number of patients expressed that the observation rounds provided much needed social interaction and relief of boredom.

> "Oh [the nurses] were wonderful. They talked to me and they did help me. I'm quite a funny sort of person and we had a laugh even though I had pain. I like a lot of laughter." (Patient 8)

> "I think you'd get bored, really [without observation rounds]. You'd have nobody to talk to." (Patient 6)

> "I like them to come and see me… I like to have a chat with them." (Patient 5)

The importance of face-to-face interactions was also highlighted when patients reported using the observation rounds for reasons other than vital signs monitoring. Patients reported asking about "my wound, going home, diet, things like that" (Patient 2). Other patients mentioned pain and stoma management as topics they often discussed during observations.

> "You talk to them and sometimes say to them, 'Well, what's going to happen?' and they'd be able to tell me things." (Patient 8)

> "When I've been in discomfort with my back or whatever, or I've needed a drink, I've asked then." (Patient 7)

(ii) Night time burden

Eight of the 12 patients mentioned their irritation at being woken up for observation rounds.

> "You're dozing off and then they come and take your blood pressure." (Patient 7)

> "I think it's too many times… especially if you're sleeping." (Patient 3)

Several patients wondered if continuous remote monitoring could replace manual observations, if only overnight.

> "I think what it would be an advantage for is the overnight things. I know they've got a job to do, but they keep waking you up. With this, you could just, you know, keep sleeping and they could monitor you through that." (Patient 2)

> "I think it will be better just because they're not coming in in the middle of the night. Because then they wake you up all the time, and you end up knackered when you're trying to heal up." (Patient 1)

> "If they're sound asleep, then just leave them alone until the next opportunity!" (Patient 12)

However, some patients mentioned that there were other things that kept them from sleep, such as noisy neighbours, bleeping machines, loud air conditioning and the

fluorescent lights, and therefore they would have difficulty sleeping regardless of whether or not they were woken up for observation rounds.

(iii) Comfort

An important issue for patients was that of comfort. Most patients (10/12) found the patch so comfortable that they forgot they were wearing it.

> "I don't know it's there. I keep thinking, 'What's that doing there?'" (Patient 5)

One patient found the patch particularly uncomfortable.

> "It feels heavy after a while." (Patient 9)

Whilst they had no complaints about comfort, two patients expressed concerns about the practicalities of wearing the patch.

> "You have to be careful… not to knock this temperature one." (Patient 2)

> "I wasn't sure if you could have a shower with one on or not." (Patient 12)

(iv) Sense of security

Although many forgot they were wearing the patch, most patients (11 out of 12) said that they felt safer wearing the continuous monitoring device. This was attributed to the knowledge that they were being monitored more frequently.

> "Knowing that they are getting 2-minute updates on my heart and stuff – it's good." (Patient 11)

These opinions were particularly prevalent amongst the patients who had seen a consequence of wearing the patch, for instance, a nurse coming to check on them in response to an abnormal reading. Other patients believed the patch would help certain people more than others, "particularly those that need a lot of monitoring," (Patient 9) or "those that… need more attention" (Patient 12). However, most patients believed it would benefit everybody.

(v) Staffing concerns

This reported sense of security was often linked to concerns about staffing. Nursing staff were described as "too busy" (Patient 4) and "on their feet all the time" (Patient 2).

> "I think [remote monitoring] is a very good idea because, you know, there just aren't so many nurses, and there are so many patients… you might not see one for a couple of hours or something, and something can happen in two hours." (Patient 11)

Many patients expressed that they saw remote monitoring having the most value for nursing staff. Patients were aware of how busy the nurses were and so could appreciate the benefit of the patch in terms of freeing up nurses' time.

> "Because of the ratio between patients and nurses, you know, it can be, like I say, a while before they come round. So this [indicating patch] is 24 hours, isn't it? They always know how you are." (Patient 6)

> "The nurses could get on with other things… so it saves time for them as well." (Patient 1)
>
> "They're so busy… they're on the go all the time. The advantage [of the patch] is that… they can use this gadget – they don't have to do as many visits, if you know what I mean, to your bedside. But they're always on hand anyway, so… You only have to press your button or give them a shout." (Patient 2)

(vi) Trust of technology

A number of patients expressed reservations about the reliability of the technology. One patient expressed concerns about data security. Others were more worried about system failure.

> "Where you had some trust in the safety of the systems, obviously I think it would be good for everyone." (Patient 6)
>
> "I know there's this thing about technology's taking over, but when it comes to nursing, you can never replace that. And then it's reliant on the wi-fi system, et cetera." (Patient 11)

However, the most common reason for mistrusting the technology was the lack of feedback, especially if no notifications were sent by the device.

> "You could just feel, 'Well, how do I know this thing's looking after me?' without a physical contact." (Patient 6)
>
> "We don't know what it does, do we? If it's working or not." (Patient 1)

## 4. Discussion

Vital signs monitoring is a universal tool for the identification of the deteriorating patient. New remote monitoring technologies, aided by wireless data transmission, have the potential to overcome the intermittent nature of current EWS systems and convey the advantages of continuous vital signs monitoring to general ward patients. Whilst it seems intuitive that continuous monitoring is safer than intermittent observations, the small number of quantitative studies in this area have shown mixed results(3). It is possible that the success of these technologies is context-dependent, and reliant on effective engagement with the technology by both patient and practitioner.

The aim of this study was to investigate patient perceptions of vital signs monitoring practices and the introduction of continuous monitoring devices on general surgical wards, in order to inform future implementations of this technology. We found that patients' experiences of manual observation rounds are generally positive, but they are perceived as burdensome for staff. They are also felt to be onerous for patients themselves at night. Remote monitoring can alleviate some of this burden, but cannot replace the benefits of face-to-face nursing contact.

These findings add novel information to the literature base. The only other study to include patient satisfaction as an *a priori* outcome measure also found that patients generally felt positive about continuous monitoring(22). However, this study was limited by its short survey design and the patient selection criteria, which was restricted to less unwell patients.

In contrast, we were able to glean a wide variety of ideas by using an analytical process with the flexibility to include emergent categories and theoretical ideas in addition to *a priori* concepts. This allowed us to retain diversity in the analysis with respect for the uniqueness of individual cases, as well as finding comparative themes and patterns.

Nevertheless, the data from this study is limited to the context it was collected and may not be valid in other contexts. Themes such as comfort will only be applicable to this specific device, although it has wider implications for patient compliance across other technologies. While the number of patients we interviewed was small, data saturation was quickly reached and researchers were satisfied with the recurrence of themes across a wide demographic.

The introduction of continuous monitoring on general wards is gaining increasing interest. It is tempting to consider such technology as a replacement for nursing contact; however, the importance of clinical acumen and experience cannot be overstated. This study confirms that patients share these perceptions and value the face-to-face nursing interaction of intermittent rounds.

We suggest that remote monitoring is introduced in a phased manner, and initially as an adjunct to usual care. Consideration should be given to replacing manual observations with remote monitoring at night, especially for low-risk patients. Attention to patient comfort and convenience should influence the design of wearable devices. Consideration of patients' experiences throughout can provide universal benefit through the enhancement of patient safety and satisfaction, and the optimisation of nursing time.

## Authors' contributions

CD, RR and DJ were involved in the conception of the work. CD and RR designed the study. RR provided methodological expertise. CD undertook the data collection. CD and RR performed the analysis and interpretation. CD and RR drafted the article. All authors were involved in critical revision of the article and have given final approval of the version to be submitted.

## Acknowledgements

The authors acknowledge assistance from the NIHR Healthcare Technologies Co-operative in Colorectal Therapies.

## Funding

This review is independent research arising from a Doctoral Research Fellowship (Candice Downey, DRF-2016-09-03) supported by the National Institute for Health

Research. The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research, Health Education England or the Department of Health.

The patients in this study were participating in a randomised controlled trial funded by a Health Foundation Innovating for Improvement Award (Grant number: GIFTS 7643 CRM 2674). The Health Foundation is an independent charity committed to bringing about better health and health care for people in the UK.

DGJ received funding support through an NIHR Research Professorship.

**Conflicts of Interest**

There are no known conflicts of interest associated with this work and there has been no significant financial support for this work that could have influenced its outcome.

**Summary table**

| **What was already known on the topic?** |
| --- |
| • Remote continuous monitoring of hospital patients is gaining popularity.<br>• These technologies depend on user engagement for their success.<br>• Nursing staff have concerns about remote monitoring decreasing bedside interactions and increasing patient anxiety. |
| **What this study adds to our knowledge** |
| • Patients understand the value of remote continuous monitoring, especially at night, but do not wish to lose face-to-face nursing contact.<br>• Remote technologies should be implemented slowly alongside traditional observations to reassure both patients and nursing staff. |

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