

BRIEF REPORT

Non-contact health monitoring to support care in a psychiatric intensive care unit

Faith Ndebele¹, Kay Wright¹, Varsha Gandhi²,
Daniel Bayley²

¹Coventry & Warwickshire Partnership NHS Trust; ²Oxehealth Limited

Correspondence to: Faith Ndebele, St James' Hospital, Edenbridge Road, Portsmouth, Hampshire, PO4 8PF, UK; f.ndebele@nhs.net

Objective: Psychiatric intensive care units provide care to patients with severe mental health disorders, often associated with violence and aggression which may result in the administration of rapid tranquillisation (RT). Novel technologies may support staff in monitoring patient safety and intervening proactively to prevent assaults and RT. The objective of this single-centre pragmatic study was to assess the effect of clinical teams augmenting their existing clinical practices with a contact-free vision-based patient monitoring system on the number of assaults and RT events.

Method: The number of incidents of assaults, and the associated use of RT, was examined before and after the introduction of a contact-free vision-based patient monitoring system in a male psychiatric intensive care unit. Staff surveys and interviews were undertaken to assess usability and acceptability of the system.

Results: There was a 37% reduction in assaults across the wards with 26% reduction in bedroom assaults. There was a 40% reduction in RT episodes related to assaults. Staff reported that they felt confident in monitoring the physical signs and health of patients remotely with the contact-free vision-based patient monitoring system to support them.

Conclusion: The results suggest that the contact-free vision-based patient monitoring system helped staff to reduce incidents of assaults and associated RT administration. Staff surveys and interviews showed the ways in which their use of this technology had supported them in physical health monitoring.

Key words: assault, mental health, rapid tranquillisation, patient monitoring, inpatient safety, contact free digital technology

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Ethics: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Introduction

Within acute psychiatric inpatient services, patients exhibiting severely disturbed behaviour are likely to be transferred to a psychiatric intensive care unit (PICU) to manage the risks posed to the patient and others. PICUs provide short-term care for patients who need intensive treatment and interventions and close monitoring due to the risk of harmful behaviours (Brown & Langrish 2006; Stewart et al. 2012). General indicators of immediate risk of violence to others may include pacing about, easily evoked startled response, hyper-vigilance and attentiveness, clenched fists and sitting on the edge of a seat (Borum 1996; Lipsedge & Rudderham Bland 1997; Kemshall 1999; Cullen et al. 2018). The strongest predictors of PICU transfer are found to be incidents of physical aggression toward others or objects and absconding or attempting to abscond (Cullen et al. 2018; Yusuf et al. 2020).

Although interventions in this environment focus on immediate management of aggressive behaviours, use of non-physical de-escalation techniques, including voluntary medication and environment planning have been reported to show beneficial effects in the long-term management of aggressive patients (Richmond et al. 2012). Effective communication techniques such as engaging the patient, providing reassurance, and redirecting the patient to a calmer personal space to gradually resolve potentially aggressive situations have shown promising results (Cowin et al. 2003). Moreover, such practices affect the staff and patient relationship, setting a positive and trusting environment. However, the burden on staff resources is much greater in the aftermath of an aggressive incident, which may be minimised if a monitoring technology can help to identify the initial signs of agitation to allow for earlier intervention or to support staff to monitor patients less intrusively during de-escalation. Often rapid tranquillisation (RT), a form of chemical restraint, is used to control severe agitation and/or violent behaviour when other nonpharmacological methods of de-escalation have failed. However, there is a drive to reduce such interventions (Department of Health & Social Care (2021).

Harmful behaviour management remains a challenge for staff in PICUs. Here we report on the use of a novel contact free system to assist staff in routine patient management and the change of number of assaults and RT events.

Oxevision is a wall-mounted system which uses computer vision and signal processing techniques to measure breathing and pulse rates and determine patient location and motion (Lloyd-Jukes et al. 2021). There are no sensors or devices attached to the patient. The system allows staff to obtain contact-free measurements of pulse rate and breathing rate, incorporating a remote visual check

on the patient. The system generates alerts and warnings if it detects that a patient is in a higher-risk location; for example, if a patient has remained in the bathroom for a prolonged length of time (they may be self-harming or using contraband) or when multiple people are detected in a bedroom. Patient privacy is maintained as there is no continuous video display. When an alert is displayed for a room, the member of staff follows a workflow allowing them the option of viewing the room, if necessary, for a limited time duration.

Method

The study was approved by the Wales REC 5 Research Ethics Committee (reference 17/WA/0193). The system (Oxevision, Oxehealth Ltd, UK), was installed in 12 bedrooms on a male PICU ward at the Coventry and Warwickshire Partnership NHS Trust. Incident data was compared 12 months pre and post use of the system during the study period (January 2018 to 31 December 2019) from 31 patients. Semi-structured staff interviews ($n = 4$) and surveys ($n = 8$) provided an insight into the usability and acceptability of this novel contact-free technology for care in this setting.

Change in the numbers of assaults and use of RT pre and post use of the system was assessed. Due to the small sample size, a bootstrap method (Davison & Hinkley 1997) with resampling was applied over subjects to assess the level of significance. Data was normalised for bed occupancy for the study duration.

Results

Our findings show that 91% of all incidents reported in the study period were assaults, which included assaults between patients as well as patient on staff assaults. 90% of these assaults were classed as low harm (NPSA 2004).

An overall 37% ($p = 0.0036$) reduction in assaults was observed across the ward with a 26% ($p = 0.33$) reduction in the number of assaults in bedrooms when the system was used (Fig. 1). The reduction in assaults can be attributed to early staff interventions following alerts generated by the system to warn of multiple people detected in a patient bedroom by a *Room Entry* warning. *Out of Room* alerts were helpful for attending to and managing patients in communal areas. This could indicate several risks including violence, aggression, assaults, and exploitation of vulnerable patients. Staff were able to respond to these alerts. Staff interviews and surveys indicated that the ability of staff members to provide effective and directed responses to prevent or mitigate harmful events was supported by information provided by the system. This information includes patient location (e.g. *In room*,

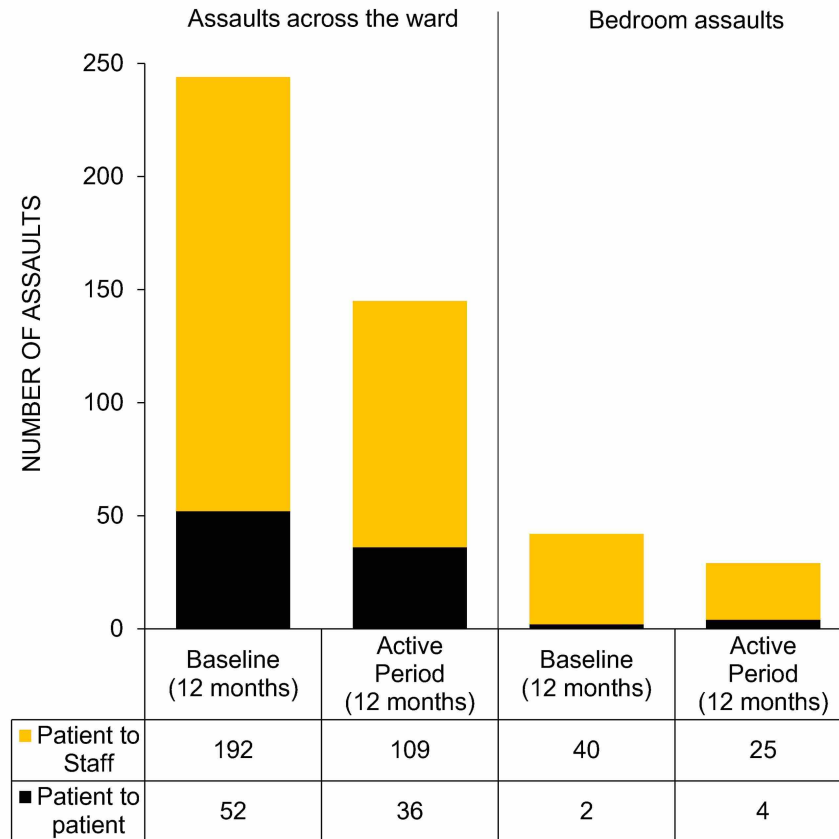


Fig. 1. Number of assaults.

In bed, Out of room). Knowing the location of all the patients centrally was thought to be useful for staff managing a large ward, where unexpected triggers may set off harmful events and require manual interventions to be directed at short notice. Staff are able to monitor patients in the bedroom in a less intrusive way, reducing the risk of escalating or re-escalating aggressive behaviour. Remote monitoring also gives patients a greater sense of agency for their safety.

Within this overall reduction in assaults, there was a small increase in patient-to-patient assaults which was clinically attributed to an increase in the severity of patient conditions.

RT events related to assaults decreased significantly by 40% ($p = 0.0018$) during the use of the system, as shown in Figure 2. Clinicians reported being able to manage situations before they escalated, leading to a reduction in the use of restrictive interventions. Staff interviews also pointed towards the benefits of being able to manage immediate patient safety in a less intrusive way, especially allowing the patient space and time to calm down and de-escalate on their own where needed. This method of observation was thought by staff to be associated with the reduction in assaults and RT. Table 1 shows the summary of the results.

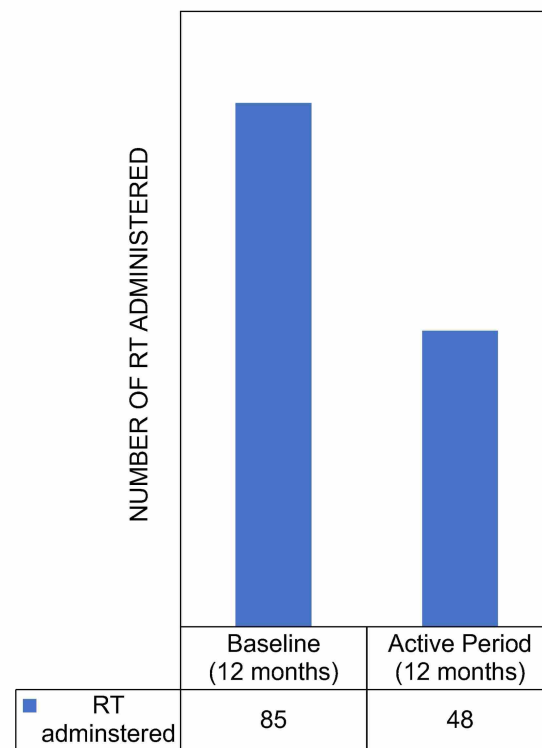


Fig. 2. Number of rapid tranquillisation events related to assaults.

Table 1. Summary of assaults and RT events.

	Baseline period (12 months)	Active period (12 months)	Change (%)	Adjusted to OBDs (%)
All assaults	244	145	-41	-37
Patient-to-patient assaults	52	36	-31	-26
Patient-to-staff assaults	192	109	-43	-39
Bedroom assaults	42	29	-31	-26
Bedroom patient-to-patient assaults	2	4	100	113
Bedroom patient-to-staff assaults	40	25	-38	-33
Rapid tranquillisations related to assaults	85	48	-44	-40
Occupied bed days (OBD)	3704	3473		

Along with the measurable outcomes presented in this report, additional patient management benefits reported by the staff indicated the usefulness of the system in better planning a patient's day. The system provided a graphical Activity Report for each patient, enabling the staff to view a summary of a patient's day and/or night levels of activities (e.g. hours spent in bed at night). This report provided a snapshot of acuity on the previous night. This appears to have been particularly useful in handovers between staff on consecutive shifts. Staff reported using this information to better plan activities during the daytime.

Periods of close observations in PICU are common, leading to an intrusive situation for the patient as well as the staff, who have to be within eyesight of each other for a prolonged period of time. This may create an environment of tension and mistrust (Chu 2016). Feedback obtained from staff pointed towards the benefits of being able to obtain information on patients' health without creating a stressful environment of 'policing' the patient, yet being able to respond immediately when needed. Creating a calming atmosphere without staff presence offers an opportunity for the patient to cope in 'their space', using the coping skills for personal de-escalation taught by staff. Having the ability to obtain regular vital signs measurements without disturbing the patient, particularly when they are sleeping, was thought to improve patient/staff therapeutic relationships.

A guidance framework created by the UK Department of Health (2014), which outlines individualised approaches and whole service approaches to provide alternate measures, has generated a national impetus to increase proactive care and reduce restrictive interventions. Systems such as the one evaluated here can support staff in providing proactive patient care and reduce the number of situations where clinicians must rely on 'on the spot' manual patient observations to make instantaneous clinical decisions.

In this study the severity of assaults remained broadly unchanged, suggesting that the system may assist staff in managing all types of incident equally (no harm through to severe harm) although this would benefit from further investigation.

Overall, staff felt more confident and in control of the use of information from the system to support their clinical activities.

Conclusion

This is believed to be the first analysis of the impact of a vision-based patient monitoring and management system in a PICU setting. Although this analysis was limited in its sample size and lacked a control cohort, the data indicates a reduction in the number of assaults, and a statistically significant reduction in rapid tranquillisation events linked to assaults.

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