



NHS INNOVATION ACCELERATOR

Economic Impact Case Study: Oxevision

Final version: January 2023

Summary

In mental health hospitals, patients require observations, either intermittently or on a '1 to 1' basis. These involve substantive staff resource and can also disturb patients' sleep when they are at night. Oxevision is a vision-based, patient monitoring system that uses a contact-free infrared-sensitive camera that measures some vital signs and can produce alerts based on the patient's location and activity in their room. This case study summarises the methods of an earlier YHEC economic evaluation of Oxevision, but presents more recent results, based on data from a larger number of trusts, analysed by the system provider: Oxehealth, using a cost calculator model developed by YHEC. The analysis considers the impact of using Oxevision on periodic night-time observations and '1 to 1' continuous observations in three inpatient settings: acute mental health services, psychiatric intensive care units (PICUs) and older adult services. The results indicate that, for an average ward in an NHS mental health trust, Oxevision could produce an annual incremental benefit value of £52,646 for older adult services, £69,181 for PICU and £37,523 for acute services over one year. This gives a return on investment (ROI) of: 1.98, 2.64 and 1.41, respectively. The results do not incorporate all the potential benefits from the use of Oxevision (for example, the impact of the technology on incidents such as self-harm, falls, assaults and restraints) and may therefore be an underestimate of the benefits value. There are some limitations to the analysis (such as assumptions about staff mix and demographic profiles of patients) which should be taken into consideration when interpreting the results.

1. BACKGROUND

In NHS mental health hospitals, patients require observation by staff to ensure their safety. These observations vary in frequency, depending on patients' circumstances, including their risk level. In general, observations are required every hour, every 15 minutes, or continuously ('1 to 1'), which require a member of staff to be physically present with a particularly high-risk patient for a continuous period. Observations are a substantial staff resource requirement for NHS mental health trusts.

As observations are required 24 hours per day, they are also taken at night, requiring staff to enter patients' rooms, can also be intrusive, disturbing their sleep and privacy, and negatively impacting the therapeutic environment. Furthermore, despite observations being frequent, and staff following care protocols, incidents may still occur.

As a response to this, Oxehealth has developed a vision-based patient monitoring system, using a contact-free optical sensor, called Oxevision. The system uses an infrared-sensitive camera housed in a secure unit which is mounted on the wall of single occupancy patient rooms. The system provides:

- Contact-free, medical grade measurements of cardio-respiratory vital signs (pulse rate and breathing rate) and trend reports from the last 24 hours.
- Real-time alerts and warnings based on clinical risk factors and the patient's location and activity in the room (e.g. edge-of-bed and out-of-bed alerts for older adults at risk of falling, and in-bathroom and at-door alerts for patients at risk of self-harm).
- Daily or weekly patient activity reports.

Clinicians can access the system through a monitor in the nurses' station and through portable tablet devices. In this way, Oxevision provides clinicians with vital signs measurements, risk alerts and confirmation that a patient is safe, without staff having to enter a patient's room or be continuously present for an extended period.

The benefits of Oxevision proposed by the system provider include:

- Reductions in the resources needed for night-time observations.
- Reductions in the resources needed for '1 to1' observations.
- Reductions in the rates of adverse events, such as self-harm, assaults and falls.
- Improvements in the patient and staff experience.

At the time of preparing this case study, Oxehealth was working with half of NHS mental health trusts in England. In 2021, York Health Economics Consortium (YHEC) undertook an economic evaluation of Oxevision with patients in three settings in a single NHS mental health trust: an acute mental health inpatient facility; an older adult mental health inpatient facility; and a psychiatric inpatient intensive care unit (PICU).¹ The economic evaluation was carried out for each patient group in relation to three perspectives: a mental health trust; a commissioner (CCGs at that time); and NHS and personal social services. In addition, the evaluations reported results for three sets of model parameters: for the trust from which the implementation data was reported; adjusted to represent an 'average' mental health ward in relation to bed numbers and occupancy levels; and adjusted to the whole NHS in England.

¹ The results of this evaluation were reported to Oxehealth and, subsequently have been published in two papers:
<https://www.tandfonline.com/doi/full/10.1080/13696998.2022.2147753>;
<https://www.tandfonline.com/doi/full/10.1080/13696998.2022.2120719>

Since the analysis for that evaluation was carried out, Oxehealth has collated more data on impact in all three settings, from additional mental health trusts. Calculations from these data – carried out by Oxehealth – have been made available from the perspective of an NHS mental health trust and adjusted to represent an average mental health ward for each hospital setting (acute, PICU and older adult).

This case study uses the earlier economic evaluation from YHEC as the basis for a description of the economic modelling methods. However, the results are based on the analysis carried out by the system provider using the more recent and larger data sample. The following sections describe the analytic approach used in the model. The results are then reported for each of the hospital settings, from a mental health trust perspective. Results from the other perspectives were not provided using the new data set.

This case study was prepared in Summer/Autumn 2022 and was based on the information and evidence available at the time. The limitations of the analysis are as follows:

- Only results for the impact on observations have been provided, using the new data set, and other benefits, including any impact on self-harm incidents, were not included in the new results, so the benefits value of Oxevision may be underestimated.
- There may be other benefits of Oxevision, such as impacts on medication or length of stay, but these were not analysed.
- There is a wide range in size and organisation of mental health trusts and wards, so adjusting the results for an 'average' ward will not provide an accurate picture of costs and benefits for some specific cases.
- The data analysis was carried out by Oxehealth and YHEC has not had a view of the data used for the analysis.

2. THE ECONOMIC MODEL

The original YHEC evaluation developed an economic model for which the values of specified metrics were input by Oxehealth, based on the data they received from NHS organisations using Oxevision. Outcomes were developed in the model for various different scenarios. As well as producing results relating to the original data set (which at the time of the YHEC evaluation were from one mental health trust), the analysis could be adjusted to show what the results would be for an average ward in an NHS mental health trust in each of the three settings. The analysis could also be scaled up to estimate what the outputs would be if the system were to be implemented across the whole NHS in England.

The model was structured as a cost calculator, using data to compare the costs of specified events with and without Oxevision. The time horizon for the calculations was one year. It was developed by YHEC and is comprehensively described in one of the peer-reviewed journal publications reporting on the single-trust economic evaluation of Oxevision. For this case study, a new analysis has been undertaken by Oxehealth, using that model with outputs provided to YHEC. The activities and costs the model captured were as follows:

- Quantity and duration of bank and agency spend related to '1 to 1' observation hours: the time for which bank and agency staff were required for continuous observations with a patient that is assessed as high risk.
- Quantity and duration of night-time observation hours: the time that staff take to check patients during the night, at intervals of every hour or every 15 minutes.

The impact of Oxevision on these costs was compared with the cost of implementing Oxevision, in order to calculate the incremental cost of the implementation (the benefits minus the cost). Additional metrics were recorded, such as self-harm incidents. However, these are not included in the analysis reported here.

The economic value of each of the relevant metrics was estimated by YHEC using the sources listed in Table 2.1.

Table 2.1: Sources for economic values of impact measures

Metric	Source of cost estimate
Staff cost for observations	Personal Social Services Research Unit, Unit Costs of Health & Social Care
Annual Oxevision license fee	Oxehealth
Installation costs ^a	Oxehealth
Cabling costs ^a	Oxehealth
Staff training costs ^a	Personal Social Services Research Unit, Unit Costs of Health & Social Care

^a Costs of implementing Oxevision were annualised over the lifespan of the intervention, which is assumed to be over 10 years, with a discount rate of 3.5%.

For all settings, it was assumed that the observations were undertaken by an Agenda for Change (AfC) Band 5 nurse or health care assistant (HCA), in the following proportions:

- HCA: 70%
- Nurse: 30%

Savings from reduced staff time spent undertaking patient observations do not necessarily result in reduced expenditure in trust budgets. For establishment staff, it is more usual that they have some time freed up to engage in other activities (i.e. they result in opportunity cost savings and are not 'cash releasing'). However, as many trusts use bank and agency staff to cover some of the staff requirements for observations, there is the potential for cash releasing savings from a reduction in the use of these staff.

Activity and cost data were used in that evaluation to calculate the economic values of the impacts of Oxevision. The following assumptions were used in the analysis:

- It was assumed that the findings from the study on specific trusts are transferable and can be scaled to different populations and settings.
- It was assumed that bank and agency staff are used when more than one staff member for '1 to 1' observations is needed, while all night-time observations are conducted within the trusts' safe staffing establishment.

The updated results were provided only for savings related to observations and the potential impact on incidents of self-harm are not included in this case study.

3. RESULTS

The YHEC economic evaluation was based on data from use of Oxevision in a single mental health trust. Since then, the system has been used in more trusts and a larger data set has been collated. This data set (which includes the original data) has been used by Oxehealth to re-calculate the results for a sub-set of the original impacts and those updated results are presented in the rest of this case study. No updated results were provided for the impact of Oxevision on self-harm incidents and therefore no reference to this issue is made in this section. The data on the costs of adopting Oxevision are taken from the YHEC evaluation reports.

3.1 Costs of Adopting Oxevision

An average acute ward in an NHS mental health trust (for patients who are generally under 65 years and do not require intensive care), is assumed to have 16 beds, based on available evidence. For PICU patients, an average ward is assumed to have 12 beds and a ward for older adults is assumed to have 16 beds. The average occupancy is assumed to be 90% across all settings.

The costs of adopting Oxevision include a licence fee paid to Oxehealth for the use of the system, plus installation costs of the equipment, cabling costs and training costs for staff. The latter three cost types are assumed to be start-up costs, which can be apportioned over ten years. To maintain commercial confidentiality, these costs are not listed separately here. The total cost over one year would be:

- Older Adult: £26,555
- PICU: £26,190
- Acute: £26,542

There is only a very small difference in costs between the settings, resulting from the different costs of staff training.

3.2 Impact on Night-Time Observations

The more recent data on the impact on night-time observations comes from three wards for each of the hospital settings (acute, PICU and older adult). The proportion of patients who required night-time observations is less than 100% in each setting, and the proportion of them who require hourly observations or observations every 15 minutes varies between settings. The night-time period during which these observations are necessary is nine hours (between 10pm and 7am).

There was a 47% reduction in the time taken to complete night-time observation rounds. This is the average reduction in night-time observations hours across the three settings analysed. Table 3.1 shows the change in observation time and the impact on costs of the introduction of Oxevision in an average mental health ward for acute, PICU and older adult settings, in relation to night-time observations.

Table 3.1: Impact of the implementation of Oxevision on night-time observations, in an average mental health ward, over one year, for three settings

Metric	Older Adult	PICU	Acute
Proportion of patients requiring night-time observations	90%	80%	90%
Proportion of patients on hourly observations	50%	0%	80%
Proportion of patients on 15 minute observations	50%	100%	20%
Average time taken to complete an observation without Oxevision (seconds)	36	36	36
Average time taken to complete an observation with Oxevision (seconds)	19	19	19
Time saved per year (hours)	502	536	321
Cost saving per year	£15,221	£16,236	£9,741

Source: results of analysis provided by Oxehealth

It is assumed that night-time observations will be opportunity cost savings, with no cash-releasing impact on trust budgets.

3.3 Impact on '1 to 1' Observations in Bank and Agency Spend

The data relating to the impact on '1 to 1' observations were collated from seven wards across three trusts for acute and PICU settings. For older adults, the data were collated from five wards across two trusts. The same bed numbers and occupancy levels are assumed as for night-time observations, for an average mental health ward, in each setting.

The impact on '1 to 1' observations can have a cash-releasing impact on trust budgets, as bank and agency staff are used when more than one staff member is required for an observation, beyond the minimum safe staffing levels for the ward. In the results reported, we understand that all of the impact is assumed to be on bank and agency staff and the time commitment of trust staff was not affected (there have to be two staff members present on a '1 to 1' observation).

Table 3.2: Impact of the implementation of Oxevision on '1 to 1' observations in bank and agency spend in an average mental health ward, over one year, for three settings

Metric	Older Adult	PICU	Acute
Average percentage reduction in cost	34%	15%	27%
Average absolute reduction in cost	£63,980	£79,135	£54,324

Source: results of analysis provided by Oxehealth

3.4 Total Impacts

Table 3.3 shows the results for the three ward settings, over one year of use. This includes the return on investment (ROI), calculated using the formula:

$$\frac{\sum \text{Total discounted benefits} - \sum \text{discounted costs}}{\sum \text{Total discounted costs}}$$

Table 3.3: Total costs and benefits for three ward settings

	Older Adult	PICU	Acute
Total costs of Oxevision	£26,555	£26,190	£26,542
Reduction in cost of night-time observations	£15,221	£16,236	£9,741
Reduction in cost of '1 to 1' observations	£63,980	£79,135	£54,324
Total benefits (night-time and '1 to 1' observations)	£79,200	£95,371	£64,065
Incremental benefit (benefits – costs)	£52,646	£69,181	£37,523
Incremental benefits (cash releasing only)	£37,425	£52,945	£27,782
ROI in relation to total benefits	1.98	2.64	1.41
ROI in relation to cash-releasing benefits only	1.41	2.02	1.05

4. DISCUSSION

Based on the analysis provided by Oxehealth, the Oxevision system can produce an incremental benefit of £52,646 for older adult services, £69,181 for PICU services and £37,523 for acute services over a one-year period. This gives ROIs of: 1.98, 2.64 and 1.41, respectively. These results are based on use in an average mental health ward, with 16 beds for older adult and acute services and 12 beds for PICU. Occupancy is assumed to be 90% in each case. When cash-releasing savings are considered only, there is an incremental cost saving of £37,425 for older adult services, £52,945 for PICU services and £27,782 for acute services over a one-year period.

These results do not include all the impacts that Oxevision might have on mental health services. There may be additional impacts on medication and/or length of stay, which it was not possible to include in the original economic evaluation. In addition, the impact on self-harm incidents was not calculated for the more recent data set. It is possible, therefore, that the above results underestimate the full impact that use of Oxevision may have on mental health services.

Some of the benefits of any reduction of incidents would impact on other services. For example, reduced A&E department visits would reduce the costs for commissioners and would reduce the burden on these services. In addition, there are also important potential benefits, such as improved sleep, for mental health patients as a result of the non-intrusive nature of observations using the Oxevision system.

There are variations between mental health trusts, such as patient demographics and staff mix, which may make these 'average' results less relevant to other trusts. In particular, the percentage and absolute amount of cash-releasing savings will vary according to each trust's policy on using bank and agency staff.