Kent Surrey Sussex Academic Health Science Network

Office for Life Sciences

NHS

Northamptonshire Virtual Wards

Rapid evaluation – Summary report

KSS Insights

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Summary report

Introduction

The COVID-19 pandemic has placed unprecedented pressure on acute care services. Concerns have been raised throughout the pandemic over the lack of available hospital beds, increased average length of stay (LoS), and the increased workload of NHS clinicians (Lacobucci, 2020). Discharging patients from an acute setting to a home setting, when clinically appropriate, may provide a viable means of reducing the pressure on acute care services, and ease patient and staff COVID-19 related concerns. Early discharge can prove difficult for some patients due to the wide variation in COVID-19 symptoms, with some patients presenting with minimal to no symptoms before rapidly deteriorating (Hu, 2020). To reduce the clinical risk of discharging patients, patients may be monitored by clinicians through a virtual ward (VW), where clinically appropriate.

NHSX commissioned this virtual ward (VW) rapid evaluation report through the National Innovation collaborative, which has been delivered in partnership with the Academic Health Science Network (AHSN). The main aim of this real-world rapid evaluation was to measure and compare the outcomes of the different VW models implemented in Northamptonshire CCG during the COVID-19 pandemic. This involved the evaluation of a traditional VW implemented at Kettering General Hospital (KGH) and a technology[tech]-enabled VW at Northamptonshire General Hospital (NGH).

The technology used for the VW at NGH was provided by Doccla, a company that seeks to provide hospitals and patients with the necessary monitoring equipment for home-based monitoring, including CE-marked wearable monitors and pre-configured smartphones (Doccla, 2021). Over the observation period, patients would take oxygen saturation measurements using the pulse oximeter, which would automatically be sent by the smartphone to a web based dashboard. Additionally, if a measurement was not obtained from a patient, Doccla contacted the patient to ensure the patient was well and was not having trouble using the product. This sought to prevent patients discharging themselves from the tech-enabled VW without notifying NGH.

This Summary report should be reviewed in conjunction with the Technical annexe and Appendices annexe to gain further detail on evaluation methodology, results, discussion, and caveats.

This report was developed in order to deliver rapid insight into the impact of technology-enabled models of care throughout the Covid-19 pandemic. It was conducted over an incredibly short time frame (approximately six weeks) using retrospective data. Whilst the evaluation has been conducted in the most prudent manner possible within the specified timeframes, the quality of the data with regards to aspects such as, small sample sizes, definitional differences (e.g., readmission), the inability to identify or control for patient comorbidities, differences in operational

decisions between the two comparison sites, and potential differences in outcomes over wave one and wave two of COVID-19, has resulted in several assumptions that have affected measurement validity types within the evaluation. Resultingly, all findings should be interpreted within this context. Further evidence is required to draw firm conclusions on the specific effects of virtual ward models on improving patient outcomes and delivering health care efficiencies.

Methodologies

A rapid evaluation framework was designed to articulate key potential evaluation questions. Data supplied by KGH and NGH were analysed to explore patient demographics, compliance rates, and several patient outcomes such as LoS on the VW, readmission rates, and staff to patient ratios. A cost-benefit analysis (CBA), with associated assumptions, was conducted to provide an estimate of whether the tech-enabled VW resulted in a positive return on investment when compared with the traditional VW model.

Qualitative and quantitative data analysis of survey and feedback data from patients and clinicians (who engaged with the VWs at each site) were used as part of a mixed methods approach. This analysis was conducted to explore patient and clinician perceptions of the VW services, including how satisfied individuals were with the VW services, and to gain insight on the patient experience of being cared for remotely through a VW. All survey and feedback data (qualitative) were collected prior to the start of the evaluation. As such, the evaluators did not have the opportunity to provide input on the survey questions or methodology; therefore, the results of the survey analysis could not be directly compared.

Further details of the evaluation methodology may be found in the “Overview of evaluation methodologies” section of the Technical annexe and Appendix E, F, G, and H of the Appendices annexe.

Results and discussion

Patient outcomes

During the six-month period, 147 and 197 patients were serviced through the traditional and tech-enabled VWs, respectively. There was no statistically significant difference between the age or sex of these patient cohorts.

Length of stay and readmissions on the virtual ward

The traditional VW had an average LoS of approximately 19 days, and a readmission rate of 5% (n=8). The tech-enabled VW had an average LoS of 10 days and a readmission rate of 11% (n=22).

Within this evaluation paradigm, a lower LoS on the tech-enabled VW contributed to potential cost savings to the NHS through a reduction in nurse cost per patient. A lower VW LoS for the tech-enabled VW may have resulted in a greater patient throughput, which may have increased capacity in acute settings. There is some evidence to suggest that the LoS of the tech-enabled VW ward changed significantly between the first and second wave. This statistical difference may have been due to external factors that impacted the LoS between the first and second waves. As such, the difference in VW LoS cannot be conclusively attributed to the different VW models.

Discussions with NGH have suggested that due to the closer monitoring of the tech-enabled VW, patient deterioration could be identified sooner; possibly leading to a higher readmission rate for the tech-enabled VW.

Due to a lack of comparative data on LoS once readmitted, a break-even analysis was conducted to understand the tech-enabled readmission average LoS required to break-even with the traditional VW outcomes (i.e., costs equal to cost savings). This LoS metric refers to the LoS where a patient is readmitted (“stepped-up”) from a VW to the hospital as an inpatient. According to the break-even analysis, the tech-enabled VW could remain cost neutral with an average 6-day hospital readmission LoS (i.e., the tech-enabled VW would be more costly, when compared to the traditional VW, if patients had a LoS of 7 days or greater). As the average LoS of a non-elective hospital readmission is approximately 4.5 days, if the tech-enabled VW were to achieve the national average, it would remain less costly than the traditional VW (NHS Digital, 2020).

Patient compliance

Patient compliance was 98.9% and 100.0% for the tech-enabled and traditional VW, respectively. Due to differences in patient compliance definitions across NGH and KGH, the metrics could not be directly compared; however, both VW patient compliance measures were considered high.

Through discussions with NGH and KGH, it has been suggested that phone calls and patient preferences may have played an important role in contributing to the high level of compliance within the two VWs. Doccla called patients when a daily measurement was not received, and KGH utilised daily monitoring check-ups from nurses. It has been suggested that these phone calls helped encourage patients to take their readings and could have enabled a high patient compliance rate across the VWs. Patients in both the tech-enabled and traditional VWs noted interactions with staff as an important factor in their recovery within the patient surveys.

Within the tech-enabled VW, compliance could have been assisted as patients were provided with a smartphone to enable remote monitoring. Therefore, patients who did not have access to this technology were enabled to take part in this pathway (i.e., addressing potential health inequality issues). It is worth noting that other technology suppliers may not offer this, which may leave some patients unable to be remotely monitored through the technology, or alternatively having to use their own devices.

Patient satisfaction

Of the COVID-19 survey respondents, 93% (n=54) of patients that returned surveys within the tech-enabled VW stated that they were satisfied or very satisfied with their experience with remote monitoring. Additionally, 100% (n=10) of traditional VW survey respondents rated their experience with the VW as good or excellent. While there may be a hypothetical risk that home monitoring solutions can exacerbate anxiety in certain patients, anecdotal evidence implies that the VWs may have aided in reducing anxiety in patients.

Findings highlight the possible importance of a contactable team within the VW model (for both patient compliance and satisfaction), who can answer patient queries through the smartphone provided, and provide reassurance when necessary. Both KGH and NGH provided this through their respective home monitoring teams (HMTs), and Doccla helped provide this reassurance through their helpdesk.

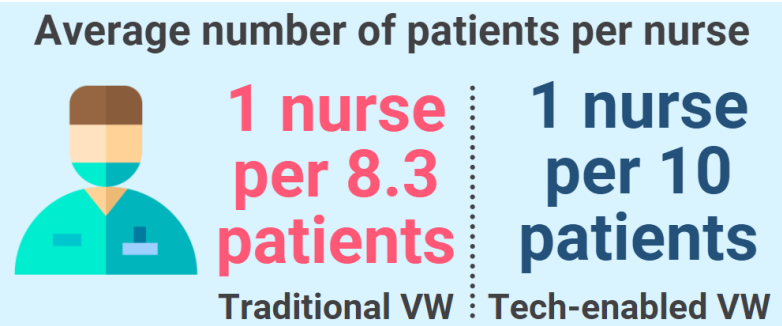
Patient mortality

Patient mortality, within the second wave of the pandemic, for the tech-enabled and traditional VW was recorded as 3% (n=4) and 1% (n=2), respectively. As the reasons for patient deaths (e.g., underlying health conditions) were unknown, conclusions on whether the type of VW contributed to patient mortality are inconclusive. Additionally, due to the low number of patient deaths in both VWs, statistical tests could not be performed to ascertain whether a statistically significant difference in patient mortality existed between the two VW models. Causes of patient deaths, and a larger patient cohort, would need to be collected to better evaluate patient mortality.

Further details of patient outcome evaluation methodologies, results, and discussion may be found in the “Results” and “Discussion” sections of the Technical annexe, and Appendix F, G, and I of the Appendices annexe.

Staff outcomes

Nurse to patient ratio



The number of nurses per patient on the traditional and tech-enabled VW was calculated to be 1 nurse per 8.3 patients, and 1 nurse per 10.0 patients, respectively. Through discussions with KGH and Doccla, it has been suggested that the higher ratio on the tech-enabled VW may be due to the ability to monitor several patients' physiological signs via the web based dashboard. By reducing the number of nurses per patient, tech-enabled VW efficiencies could have released nurse capacity for further care (i.e., extra capacity to care for other patients). As the nurse-to-patient ratios were deduced from site data and communications with NGH and KGH, the number of nurses per patient should be interpreted with caution.

Notably, a remote monitoring system offers flexibility for staff who may have to work remotely. For example, staff that were shielding at NGH were able to monitor patients on the VW. This may represent a key benefit of tech-enabled VWs, as this may not be possible with a traditional VW given the lack of technology to assist with the streamlined communication with patients.

Staff satisfaction

Whilst limited, the feedback provided by staff at NGH could imply that tech-enabled VWs may be acceptable to some clinicians:

> *"We have all been really impressed with the Doccla system and this superb level of service from your team."*
>
> *(NGH home monitoring team doctor, 2020)*

Additionally, findings from Vindrola-Padroa et al. (2021) indicated that staff perceive VW monitoring as a safe way to deliver appropriate care to patients. This preliminary evidence may suggest that staff can manage patients and deliver required care through the VW models. Findings may demonstrate that staff accept VWs as a method to deliver care and that the VW models could be a feasible alternative for certain patient cohorts.

Further details on staff and patient outcome evaluation methodologies, results, and discussion may be found in the "Results" and "Discussion" sections of the Technical annexe, and Appendix F, G, and I of the Appendices annexe.

Health economic outcomes

Cost-benefit analysis

According to the in-year analysis, the tech-enabled VW resulted in savings when compared with the traditional VW. Total in-year health economic outcomes of the tech-enabled VW, relative to the traditional VW (2020/21), demonstrated:

- **Total benefits (difference in benefits of tech-enabled VW when compared to traditional VW):** £74k
- **Total costs (difference in costs between the tech-enabled when compared to traditional VW):** £24k
- **Total net impact:** £50k
- **Impact implementation cost ratio:** 3.1, indicating that for every £1.00 invested in the tech-enabled VW, instead of the traditional VW, an additional return of £3.10 could be expected.

The biggest driver for the economic outcomes was the difference in the cost of the tech-enabled and traditional VW (i.e., if the tech-enabled VW becomes more expensive, then overall impacts of the tech-enabled VW will decrease). Whilst Doccla was the only tech-enabled VW evaluated within this report, the findings may be used to indicate the outcomes of comparative tech-enabled VW solutions implemented within the NHS.

This project sought to identify key monetisable benefits of the tech-enabled COVID-19 VW; however, possible benefit streams that have not been monetised but may deliver health gains for clinicians and patients include:

- Mental wellbeing of patients with COVID-19 post-discharge
- Mental wellbeing of acute care clinicians
- The outcomes of continuous monitoring
- Utilisation of shielding staff

It is worth noting that there may be other cash and non-cash releasing benefits which may be considered for future evaluation; however, these benefits have not yet been identified (i.e., emerging benefits).

Further details on the health economic methodologies, results, and discussion may be found in the “Overview of evaluation methodologies”, “Results”, and “Discussion” sections of the Technical annexe, and Appendix H, J, and K of the Appendices annexe.

Key recommendations

These findings provide preliminary evidence to support the adoption of tech-enabled VWs; although further evidence in non-COVID VW care pathways is required to improve the evidence base to support tech-enabled VW adoption. As part of the implementation process, there are several mechanisms which could enable the correct data and metrics to be captured to aid the evaluation of VW benefits.

Key recommendations to best implement tech-enabled VWs at scale include:

- Developing a more standardised implementation and staff approach for VWs (e.g., detailing banding and hourly requirements of clinical staff).
- Planning data collection and evaluation requirements across Trusts before a pilot study is conducted. This should allow for key metrics to be defined and collected within a similar manner and enable an appropriate comparator to be established. This evidence will enable evaluators to better articulate the benefits of VW models. Key metrics to collect and define to enable appropriate comparator data include:
    - LoS before admission to the VW.
    - Uptake and LoS on the VW, and patient compliance.
    - Readmission from VW: readmission rate, reason for readmission, and LoS of readmission.
    - Metrics detailing patient mortality and likely causes thereof.
    - Clinical outcomes beyond LoS and readmission rate.
- Considering evaluations which may assess the monetisation of quality-adjusted life years (QALYs), and may provide a wider view on the benefits that a VW model could realise.
- Considering evaluations forecasted over a more substantive period (e.g., three or five years), which could produce more robust economic metrics such as net present value (NPV) and benefit-cost ratio (BCR), to show more medium- and long-term outcomes. As the analysis was focussed on the incremental benefit of tech-enabled VWs in comparison to traditional VWs, the findings from this CBA could form part of a useful decision tool for sites that are deciding which VW model to implement at a site (i.e., the analysis does not detail the benefits of the standard care pathway against possible benefits derived through VW models).
- Conducting further UK studies to articulate VW value within COVID-19 pathways and other patient pathways (e.g., COPD and asthma). Evaluations of this nature could improve our understanding of patient compliance with VW models across other patient pathways, which may differ in severity.

Further details on the recommendations from this evaluation may be found in the “Recommendations” section of the Technical annexe.

Caveats

This rapid evaluation was produced over an incredibly short time frame (approximately six weeks) using retrospective data (i.e., extensive research and evaluation planning was not undertaken with input from the evaluators before VW implementation). Whilst the evaluation has been conducted in the most prudent manner possible within the specified timeframes, the quality of the data with regards to aspects such as, small sample sizes, definitional differences (e.g., readmission), the inability to identify or control for patient comorbidities, differences in operational decisions between the two comparison sites (e.g., seniority of nurses monitoring patients), and potential differences in outcomes over wave one and wave two of COVID-19, has resulted in several assumptions that have affected measurement validity types within the evaluation. Additionally, differences in the VW models, such as some traditional VW patients requiring oxygen, limited the ability to directly compare these two patient cohorts.

As the analysis was focussed on the incremental benefit of tech-enabled VWs in comparison to traditional VWs; the findings from this CBA do not demonstrate the health economic impacts of a VW model in comparison to the standard care pathway. Key assumptions pertaining to the CBA have been further detailed in the “Overview of evaluation methodologies” section of the Technical annexe.

There is a lack of clear benefit attribution to the adoption of a VW model to treat COVID-19 patients at NGH and KGH. For example, further evidence is required to draw firm conclusions on specific VW effects on LoS and readmission rate; within this evaluation paradigm there were insufficient data to evidence that a reduced LoS can be solely attributed to the use of a tech-enabled VW. Additionally, the extent of the effects of factors such as the case mix; any changes in the VW service offer during the COVID-19 pandemic; and underlying health conditions of patients on key metrics such as the LoS, the nurse-to-patient ratio, and readmission rates across VWs, remains unknown.

When considering the nurse-to-patient ratio and the LoS, the following points should be noted:

- The ratio of nurses to patients was calculated through available data and communications with NGH and KGH. As such, the number of nurses per patient should be interpreted with caution as this was not obtained via reliable data sources such as audited FTE data.
- There is some evidence to suggest that the LoS of the tech-enabled VW ward changed significantly between the first and second wave. As such, there may have been unaccounted external factors that impacted the LoS between the first and second wave. Additionally, a reduction in LoS on the VW does not necessarily improve patient outcomes (“Discussion” section of the Technical annexe).

Further caveats of key metrics (e.g., hospital readmissions, LoS of a readmission from the VW, cost of implementation at NGH, VW nurse banding and number, of nurses per patient), and interpretations of findings have been further detailed within the “Caveats” section of the Technical annexe.

Concluding remarks

Preliminary evidence from this real-world rapid evaluation suggests that patients are compliant and are satisfied with VW remote monitoring solutions. Concrete evidence on non-inferior patient and staff outcomes when comparing the tech-enabled and traditional VW could not be obtained through this evaluation due to a lack of comparable data (e.g., readmissions defined in the same way). Further evaluations should be conducted to obtain more definitive evidence on the feasibility and acceptability of tech-enabled VWs in comparison to traditional VWs.

Discharging patients from an acute setting to a VW, when clinically appropriate, could provide a viable means of reducing the pressure on acute care services, and ease patient and clinical staff COVID-19 related concerns.