Quantitative results of the Oxehealth system

Essex Partnership University NHS Foundation Trust

Executive Summary

Essex Partnership University NHS Foundation Trust (EPUT) partnered with Oxehealth to improve the safety, quality and efficiency of care provided across inpatient wards.

This report was prepared by evaluating the quantitative impact of implementing the Oxehealth Service in four wards (the "active wards") at EPUT: Ardleigh (female acute), Peter Bruff (mixed assessment), Chelmer (female acute) and Hadleigh (mixed PICU).

The report assesses the Oxehealth system's impact on:

- Self-harm and assault incidents
- Bank and agency spend related to 1:1 observations

To evaluate the impact of the Oxehealth system on active wards, change in incidents and bank and agency spend related to 1:1 observations was evaluated before and after the system was implemented, and where possible, compared against a control ward. Galleywood (female acute) was used as a control ward to Ardleigh and Chelmer. Basildon Assessment Unit was used as a control ward to Peter Bruff.

Confounders were considered to understand factors other than the Oxehealth system that could have impacted the results of the study. It is important to consider these results under the limitations of these confounders, especially given the nature of the pandemic and its impact on these data.

PATIENT SAFETY

There was a 15% relative decrease in self-harm and assault incidents on the active wards when compared to the control wards.[1]

The number of self-harm incidents on the active wards reduced either in absolute terms or relative to a control ward in the bedroom and across the ward. For the active wards, Ardleigh, Chelmer and Peter Bruff had a relative reduction in self-harm incidents across the ward when compared to control wards of 39%, 47% and 39% respectively, and Hadleigh reduced by 37% in absolute terms. In bedrooms, self-harm incidents had a relative reduction of 68%, 73% and 55% compared to their control ward for Ardleigh, Chelmer and Peter Bruff respectively, and Hadleigh reduced by 20% in absolute terms.

There was also a reduction in absolute terms in harmful[2] self-harms (67%) and A&E visits related to self-harm (12%) on the active wards.

The total number of assaults on active wards decreased by 4% in absolute terms, however the results varied by ward. Ardleigh and Chelmer reduced assaults across the ward by 20% and 43% in absolute terms respectively, but there was a relative increase in assaults when compared to the control ward, Galleywood, by 86% and 32% respectively due to a large reduction in assaults on Galleywood. Peter Bruff had a relative reduction in assaults by 10% compared to its control ward, Basildon AU., and assaults on Hadleigh increased by 70% in absolute terms.

[1] Relative percentage change is used to compare the rate of change of an active ward to the rate of change of a control ward. Therefore, the active ward performance relative to the control ward is calculated. The formula used is: ((Active ward incident post go-live) / (Active ward incident baseline)) / ((Control ward incident post go-live) / (Control ward incident baseline))

[2] Harmful incidents are incidents classified as moderate degree of harm or higher. A moderate degree of harm incident is an incident that resulted in significant but not permanent harm, e.g. a fracture.

The was an increase in absolute terms in harmful assaults from 1 to 4 and in A&E visits related to assaults from 2 to 12 on the four active wards. The two control wards increased harmful assaults from 0 to 3 and reduced A&E visits related to assaults from 4 to 3 in absolute terms.

Despite Ward Managers reporting higher patient acuity in Ardleigh, Chelmer and Peter Bruff, these data indicate that the Oxehealth system has improved patient safety and helped to reduce the number of self-harms, and while the results for assaults varied by ward, the system helped to reduce the number of assaults overall.

It must be noted that these results are not statistically significant, and the effect of COVID-19 is likely to have impacted the data these results are based on, despite attempts to mitigate its effect by managing evaluation periods.

VALUE FOR MONEY

Bank and agency hours data was categorised by COVID-19, high acuity, 1:1 observations and other (e.g. established vacancies and sickness).

All active wards reduced bank and agency spend related to 1:1 observations, varying from a 27% to 64% reduction in absolute terms.

Overall, there was a 43% total reduction in bank and agency spend related to 1:1 observations across the four active wards, equivalent to an annual cashable saving of £516,679 and a positive cashable return on investment of 417% (£516,679 saved versus £100,000 service license cost for the four wards).

Interpreting the data

Ardleigh (female acute) and Peter Bruff (mixed assessment) went live with the Oxehealth system in April 2020, then Chelmer (female acute) and Hadleigh (mixed PICU) went live in August 2020.

Galleywood (female acute), Basildon Assessment Unit (mixed assessment) and Christopher (mixed PICU) were shortlisted and assessed as potential control wards for the active wards.

Identifying control wards for cohort analysis

The following criteria were considered to evaluate the suitability of control wards with active wards:

- Ward pathway
- Patient gender
- ICD10 demographic[3]
- Ward and room design
- Patient length of stay
- The number of baseline incidents[4]
- The baseline Bank and Agency spend related to high acuity and 1:1 observations
- Operational confounders.

Galleywood was used as a control ward for Ardleigh and Chelmer. Basildon Assessment Unit (AU.) was used as a control ward for Peter Bruff. This was a "before and after" cohort study design to evaluate the impact of the Oxehealth system, whereby the change in self-harm and assaults was compared with data from a suitable control ward, while bank and agency spend related to 1:1 observations was compared before and after go-live (i.e. without a control ward).

Christopher was considered as a potential control ward for Hadleigh. However, Christopher is a smaller ward (10 vs. 15 bedrooms with only 6 vs. 15 en-suite rooms) and experienced a significant change in patient diagnoses between the baseline period and post go-live period. The proportion of patients with mood disorders increased from 9% to 40% while personality disorders decreased from 32% to 8%. This change would have likely influenced the incidents and bank and agency spend when comparing Christopher's baseline period to post go-live period. Therefore, there was not a suitable control ward, and Hadleigh's results were evaluated by comparing the baseline period to the post go-live period only (a traditional "before and after" study design).

Please see the next page for a summary of control ward suitability. The control wards were compared using a RAG (Red Amber Green) rating to visualise suitability.

[3] Correlation of ICD10 codes between wards was assessed using Spearman's rank correlation coefficient which assesses compatibility of relationship between variables. Results range from 1.0 – 0, the closer to 1.0 the more similar the patient ICD10 demographic. For this evaluation, 1.0 – 0.70 was considered to be high correlation (green), 0.70 – 0.5 as moderate correlation (amber), as 0.49 – 0 as low correlation (red).

[4] The percentage difference between length of stay, baseline incidents and bank and agency spend related to High Acuity and 1:1 observations was used to assess compatibility. Less than 50% difference was considered to be similar magnitude (green), 50%-99% difference was somewhat similar (amber) and greater than 100% was not similar (red).

Comparison of suitability criteria between the active wards and potential control wards

Criteria	Ardleigh	Galleywood	Suitability	Chelmer	Galleywood	Suitability	Peter Bruff	Basildon Assessment Unit	Suitability	Hadleigh	Christopher	Suitability
Pathway and gender	Female acute	Female acute		Female acute	Female acute		Mixed assessment	Mixed assessment		Mixed PICU	Mixed PICU	
Ward environment	18	18		16 en-suite, + 2 swing rooms	18		17	19		15 en-suite	10 (6 en-suite)	
Baseline ICD10 correlation	High			High			High			High		
Post go-live ICD10 correlation	High			High			High			Moderate		
Length of stay (median)	32	28		28	28		7	5		47	23	
Baseline ward self-harms	197	23		128	23		190	51		45	64	
Baseline ward assaults	102	66		91	66		55	40		45	132	
Baseline bedroom self-harms	132	9		128	9		120	28		35	64	
Baseline bedrooms assaults	8	12		6	12		4	8		10	73	
Baseline bank and agency spend for 1-to-1 and high acuity	£59,630	£64,986		£42,678	£64,986		£265,571	£176,524		£1,180,707	£533,336	
Unique confounders	**Ardleigh**: increased acuity **Galleywood**: Change in Ward Manager and increased staffing establishment from 5 to 6 in Mar-20. Incidents reduced by nearly half from Mar-20 onwards. No increase in acuity.			**Chelmer**: increased acuity **Galleywood:** Change in Ward Manager and increased staffing establishment from 5 to 6 in Mar-20. Incidents reduced by nearly half from Mar-20 onwards. No increase in acuity.			**Peter Bruff:** Increased acuity **Basildon AU**.:Became a 'red route' ward from Mar-20 onwards which increased staffing and all admissions for Basildon and Rochdale Hospital went via Basildon AU.			**Hadleigh**: None **Christopher**: Proportion patient OBDs changed from 9% to 40% for mood disorders and 32% to 8% for personality disorders in post-go live period.		

Identifying evaluation periods for "before and after" analysis

The evaluation periods for the wards were:

Ward	Baseline period	Post go-live period
Active wards		
Ardleigh	Apr 2019 to Mar 2020 (12 months)	Apr 2020 to Jul 2021 (16 months)
Peter Bruff	Apr 2019 to Mar 2020 (12 months)	Apr 2020 to Jun 2021 (15 months)
Chelmer	Mar 2020 to Jul 2020 (5 Months)	Aug2020 to Jan 2021 (6 months)
Hadleigh	Mar 2020 to Jul 2020 (5 Months)	Aug 2020 to Jul 2021 (12 months)
Control wards		
Galleywood	Mar 2020 to Jul 2020 (5 Months)	Aug 2020 to Jan 2021 (6 months)
Basildon AU.	Apr 19 to Mar 2020 (12 Months)	Apr 2020 to Jun 2021 (15 months)

Evaluation periods were chosen to maximise the evaluation period, and aligned to the evaluation periods possible for control wards to maintain a like-for-like comparison.

The period at which the control wards went live with the system were excluded from the evaluation period to ensure the system's impact did not influence the results on the control wards. Therefore, the evaluation period for some active wards was reduced in the post-go live period in order to have an evaluation period that only compared active wards with control wards not using the system.

There was a significant and sustained drop in incident levels from March 2020 on Galleywood due to a confounder effect. In a confounder interview with the Ward Manager, the 3 changes identified in March 2020 were the start of COVID-19, change in Ward Manager, increase in the staffing establishment from 5 to 6 due to COVID-19. In addition, Galleywood's go-live date for the Oxehealth system was February 2021. Therefore, to avoid the confounder effect and the impact of the Oxehealth system in the analysis, the evaluation period for Galleywood was March 2020 to January 2021.

Galleywood was a control ward for Chelmer. Therefore, to have a like-for-like comparison with Galleywood, Chelmer's evaluation period was March 2020 to January 2021.

Galleywood was also a control ward for Ardleigh. Ardleigh went live in April 2020. Therefore, using the same evaluation period as Galleywood (March 2020 to January 2021) to have a like-for-like comparison would give one month of data in the baseline period. This was not a sufficient baseline period for the evaluation and therefore Ardleigh's evaluation period was maximised instead of being like-for-like with Galleywood.

Basildon Assessment Unit's go-live date for the Oxehealth system was July 2021. Therefore, Basildon Assessment Unit's evaluation period ended in June 2021 to avoid the impact of the system on results. Basildon Assessment Unit was the control ward for Peter Bruff. Therefore, Peter Bruff's evaluation period also ended in June 2021 to ensure the ward could be compared like-for-like with Basildon Assessment Unit.

Hadleigh did not have a control ward and therefore its evaluation period was maximised.

Considering operational confounders

Ward Managers and Matrons were interviewed to identify potential operational confounders. Interviewees were asked about changes to patient demographics and acuity, staffing ratio and mix, clinical governance and policies (including any new clinical or operational initiatives), use of technology and the impact of COVID-19.

Across all wards, the number of temporary support workers and nurses increased due to COVID-19. Ardleigh, Peter Bruff and Chelmer stated that patient acuity increased due to COVID-19. The primary reason stated for increased acuity was because patients did not have the same support network and contact with the community teams, and therefore their mental health had deteriorated more (vs. pre-COVID times) before they were identified for need of support and admitted to the ward.

Basildon AU. became a "red route" ward for admissions in March 2020. This meant that all admissions for Basildon Mental Health Unit and Rochford Hospital went through Basildon AU. Therefore, Basildon AU. had a higher proportion of patients detained under section 2 and 3 of the Mental Health Act 1983. To manage the changes of being a red route ward, support workers increased from 4 in the dayshift and 3 in the nightshift to 14 and 12 respectively.

Active wards had a relative reduction in incidents compared to control wards

There was a 15% relative decrease in self-harm and assault incidents on the active wards when compared to the control wards.

Self-harm across the ward decreased in absolute terms or had a relative decrease compared to control wards

In absolute terms, self-harm incidents across the ward on Ardleigh, Chelmer and Peter Bruff was unchanged or slightly increased. However, Ardleigh, Chelmer and Peter Bruff had a relative reduction of self-harm incidents across the ward compared to their control wards by 39%, 47% and 39% respectively. Self-harm incidents across the ward on Hadleigh reduced by 37% in absolute terms.

Annualised self-harm incidents <u>across the ward</u> (includes bedroom incidents)

	Ward	Baseline	Post go-live	Change (%)	Relative change (%)
Female Acute	**Ardleigh**	**182**	**214**	**17%**	**-39%**
	Galleywood	23	45	93%	
	Chelmer	**114**	**116**	**2%**	**-47%**
	Galleywood	23	45	93%	
Mixed Assessment	**Peter Bruff**	**170**	**172**	**1%**	**-39%**
	Basildon AU.	51	84	66%	
Mixed PICU	**Hadleigh**	**45**	**28**	**-37%**	**N/A**

Self-harm in the bedroom decreased in absolute terms or had a relative decrease compared to control wards

In absolute terms, self-harm incidents in bedrooms on Ardleigh, Chelmer and Peter Bruff was unchanged or slightly increased. However, compared to their control wards, self-harm incidents had a relative reduction of 68%, 73% and 55% respectively. Self-harm incidents across the ward on Hadleigh reduced by 20% in absolute terms.

Two wards had en-suites in all bedrooms, Hadleigh and Chelmer. Chelmer reduced en-suite self-harm incidents by 56% in absolute terms, while Hadleigh had a very small sample size and increased en-suite self-harm incidents from 0 to 3.

Annualised self-harm incidents in the bedroom only[5]

	Ward	Baseline	Post go-live	Absolute change (%)	Relative change (%)
Female Acute	**Ardleigh**	**115**	**137**	**19%**	**-68%**
	Galleywood	9	33	275%	
	Chelmer	**114**	**114**	**0%**	**-73%**
	Galleywood	9	33	275%	
Mixed Assessment	**Peter Bruff**	**106**	**111**	**5%**	**-55%**
	Basildon AU.	28	66	132%	
Mixed PICU	**Hadleigh**	**35**	**28**	**-20%**	**N/A**

Annualised self-harm incidents in en-suites[6]

	Ward	Baseline	Post go-live	Change (%)
Female Acute	Chelmer	14	6	-56%
Mixed PICU	Hadleigh	0	3	N/A

Ligatures across the ward and in the bedroom decreased in absolute terms or had a relative decreased compared to control wards[7]

In Ardleigh and Chelmer, ligature incidents in bedrooms had a relative reduction of 81% and 85% respectively compared to their control wards. In Peter Bruff, ligature incidents in the bedroom reduced by 9% in absolute terms despite a relative increase compared to their control ward. Ligature incidents in the bedroom on Hadleigh reduced by 11% in absolute terms.

When comparing ligatures across the ward, the same trends were reflected in the data.

Two wards had en-suites in all bedrooms, Hadleigh and Chelmer. Chelmer reduced en-suite ligatures incidents by 100% (14 to 0) in absolute terms, while Hadleigh had no en-suite ligature incidents in the baseline or post go-live periods.

[5] Bedroom incidents include bathroom incidents for Chelmer, Hadleigh and Christopher as the majority of bedrooms on these wards had en-suites.

[6] En-suites are the bathrooms in bedrooms, for which Chelmer and Hadleigh had all bedrooms with en-suites and therefore have been included in the table.

[7] Ligatures are a subcategory of self-harm incidents. Therefore, the self-harm results include ligatures and any other types of self-harm.

Annualised ligatures in the bedroom only[8]

	Ward	Baseline	Post go-live	Absolute change (%)	Relative change (%)
Female Acute	**Ardleigh**	**65**	**79**	**21%**	**-81%**
	Galleywood	3	18	533%	
	Chelmer	**68**	**64**	**-5%**	**-85%**
	Galleywood	3	18	533%	
Mixed Assessment	**Peter Bruff**	**64**	**58**	**-9%**	**22%**
	Basildon AU.	20	15	-25%	
Mixed PICU	**Hadleigh**	**6**	**5**	**-29%**[9]	**N/A**

Annualised ligature incidents across the ward (includes bedroom ligature incidents)

	Ward	Baseline	Post go-live	Change (%)	Relative change (%)
Female Acute	**Ardleigh**	**85**	**100**	**18%**	**-72%**
	Galleywood	6	24	322%	
	Chelmer	**70**	**68**	**-3%**	**-77%**
	Galleywood	6	24	322%	
Mixed Assessment	**Peter Bruff**	**87**	**82**	**-5%**	**45%**
	Basildon AU.	28	18	-38%	
Mixed PICU	**Hadleigh**	**6**	**6**	**-11%**[10]	**N/A**

Annualised ligature incidents in en-suites[11]

	Ward	Baseline	Post go-live	Change (%)
Female Acute	Chelmer	14	0	-100%
Mixed PICU	Hadleigh	0	0	N/A

Overall, active wards reduced incidents of assaults in absolute terms, but results varied widely by ward

The number of bedroom assaults was low in both baseline results and post go-live periods, therefore the analysis was limited by a small sample size. Care should be taken when interpreting the results.

The total number of assaults across active wards decreased by 4% in absolute terms.

- Ardleigh reduced assaults by 20% but had a relative increase of 86% compared to its control ward

[8] Bedroom incidents include bathroom incidents for Chelmer, Hadleigh and Christopher as the majority of bedrooms on these wards had en-suites.
[9] Incident numbers in the table are rounded to the nearest whole number. The exact incident rates are 6.37 and 4.52 for the baseline and post go-live periods respectively, generating a reduction of 29%.
[10] Incident numbers in the table are rounded to the nearest whole number and therefore there is still a change in incident rates despite the incidents rates looking unchanged
[11] En-suites are the bathrooms in bedrooms, for which Chelmer and Hadleigh had all bedrooms with en-suites and therefore have been included in the table

- Chelmer reduced assaults by 43% but had a relative increase of 32% compared to its control ward
- Peter Bruff increased assaults in absolute terms but had a relative decrease of 10% compared its control ward
- Hadleigh increased assaults by 70% in absolute terms.

The number of bedroom assaults was low in both baseline results and post go-live periods, therefore the analysis was limited by a small sample size. The results are summarised in the "Annualised assault incidents in the bedroom only" table below.

Annualised assault incidents in the bedroom only[12]

	Ward	Baseline	Post go-live	Change (%)	Relative change (%)
Female Acute	**Ardleigh**	**8**	**9**	**8%**	**24%**
	Galleywood	12	10	-12%	
	Chelmer	**5**	**4**	**-26%**	**-16%**
	Galleywood	12	10	-12%	
Mixed Assessment	**Peter Bruff**	**3**	**21**	**565%**	**78%**
	Basildon AU.	8	29	273%	
Mixed PICU	**Hadleigh**	**10**	**21**	**125%**	**N/A**

Annualised assault incidents across the ward (includes bedroom incidents)

	Ward	Baseline	Post go-live	Change (%)	Relative change (%)
Female Acute	**Ardleigh**	**98**	**78**	**-20%**	**86%**
	Galleywood	66	28	-57%	
	Chelmer	**81**	**46**	**-43%**	**32%**
	Galleywood	66	28	-57%	
Mixed Assessment	**Peter Bruff**	**49**	**63**	**29%**	**-10%**
	Basildon AU.	40	57	43%	
Mixed PICU	**Hadleigh**	**45**	**76**	**70%**	**N/A**

[12] Bedroom incidents include bathroom incidents for Chelmer, Hadleigh and Christopher as the majority of bedrooms on these wards had en-suites.

Active wards reduced harmful self-harms and self-harm related A&E visits

The conclusions for harmful incidents and A&E visits are consistent with the previous section on incidents; self-harm related events reduced in the active wards, while assault related events increased. It should be noted that there was a much smaller size for assaults compared to self-harms. In the active ward's baseline period, there was 1 harmful assault and 12 assaults related to A&E and 6 harmful self-harms and 34 self-harms related to A&E.

Harmful self-harm incidents reduced more on the active wards than control wards

Harmful self-harm incidents reduced in absolute terms by 67% (6 to 2) for active wards and by 50% (2 to 1) for control wards.

Severity of self-harm <u>across the ward</u> (includes bedroom incidents)

	Ward	Status	Severity			Relative change (%)
			No / Low	Moderate	Death / Catastrophic	
Female Acute	**Ardleigh**	Baseline	179	2	1	N/A
		Post go-live	213	1	0	
	Galleywood	Baseline	23	0	0	
		Post go-live	45	0	0	
	Chelmer	Baseline	114	0	0	N/A
		Post go-live	116	0	0	
	Galleywood	Baseline	23	0	0	
		Post go-live	45	0	0	
Mixed Assessment	**Peter Bruff**	Baseline	167	3	0	-45%
		Post go-live	171	1	0	
	Basildon AU.	Baseline	49	1	1	
		Post go-live	83	1	0	
Mixed PICU	**Hadleigh**	Baseline	45	0	0	N/A
		Post go-live	28	0	0	

Self-harm incidents related A&E visits decreased on the active wards and increased on the control wards

Overall, self-harm related A&E visits decreased in absolute terms by 12% (34 to 30) on the active wards and increased in absolute terms 15% (13 to 15) on the control wards. Results varied by ward.

Annualised self-harm related A&E visits <u>across the ward</u> (includes bedroom incidents)

	Ward	Baseline	Post go-live	Change (%)	Relative change (%)
Female Acute	**Ardleigh**	**14**	**20**	**48%**	**215%**
	Galleywood	9	4	-53%	
	Chelmer	**5**	**0**	**-100%**	**-77%**
	Galleywood	9	4	-53%	
Mixed Assessment	**Peter Bruff**	**15**	**9**	**-35%**	**100%**
	Basildon AU.	4	11	178%	
Mixed PICU	**Hadleigh**	**0**	**1**	**100%**	**N/A**

The system acted as an early warning sign to 1 in 4 self-harm events in bedrooms

Staff recorded that the system acted as an early warning in almost one in four of all bedroom self-harm incidents. This shows that staff were able to provide better patient safety by having the system as an additional tool to support them with caring for patients.

Reporting trends suggest that this likely underestimates the number of self-harm events where the system acted as an early warning. Adherence to reporting when Oxehealth was involved was not fully adherent. Wards would benefit from further training or a reminder on how and when to mention the system alerted to an incident.

Self-harm incidents alerted by the system <u>in the bedroom only</u>[13]

	Ward	Proportion of bedroom self-harms alerted to by the system
Female Acute	**Ardleigh**	**37%**
	Chelmer	**12%**
Mixed Assessment	**Peter Bruff**	**14%**
Mixed PICU	**Hadleigh**	**0%**
	Total[14]	**24%**

[13] Bedroom incidents include bathroom incidents for Chelmer, Hadleigh and Christopher as the majority of bedrooms on these wards had en-suites.

[14] This total is calculated by dividing the total number of bedroom self-harm incidents that were alerted to by the Oxehealth system by the total number of bedroom self-harm incidents.

There was a positive in-year cashable return on investment

Bank and agency hours can be segmented by reason. The reasons include 1:1 observations, high acuity, COVID-19, establishment vacancies, sickness and training.

The system can help staff to better manage patient risk while enabling less restrictive practices. This includes taking a positive risk (where clinically appropriate) in stepping down 1:1 observations sooner or completely for some patients. Therefore, an analysis of the impact of the system specifically on 1:1 observations for bank and agency hours was conducted.

There was a 43% total reduction in bank and agency spend related to 1:1 observations on the four active wards, saving £516,679 per year.

This equates to a positive cashable return on investment of 417%.[15]

Annualised 1:1 bank and agency spend across the ward[16]

	Ward	Baseline	Post go-live	Change (%)	Saving (£)
Female Acute	**Ardleigh**	£38,552	£13,615	**-65%**	**£24,937**
	Chelmer	£57,382	£39,233	**-32%**	**£18,150**
Mixed Assessment	**Peter Bruff**	£32,417	£23,665	**-27%**	**£8,761**
Mixed PICU	**Hadleigh**	£1,060,120	£595,289	**-44%**	**£464,831**
	Total	**£1,188,471**	**£671,802**	**-43%**	**£516,679**

The change in bank and agency spend related to 1:1 observations in the four active wards has not been compared to the two control wards because the total amount saved on the active wards would be compared with fewer wards and therefore the comparison would not be like-for-like. It should be noted that the control wards reduced bank and agency spend related to 1:1 observations less than the active wards, and therefore even if compared, there would still be a significant positive in-year cashable return on investment for the active wards. The change in bank and agency spend related to 1:1 observations for the control wards can be viewed in the appendix.

[15] £516,679 annual saving versus £100,000 annual service license cost. This assumes a licensing fee cost of £25,000 per ward for the Oxehealth Service. The return on investment formula used was: (Net saving) / (cost of the system).

[16] On Chelmer, August 2020 was considered to be an outlier month for bank and agency spend related to 1:1 observations. There were several patients with a diagnosis of unemotionally unstable personality disorder. The acuity on the ward increased due to the combination of these patients and therefore there were 3-4 patients on level 3 observations (i.e. 1:1 observations) throughout August 2020. This was considered to be an outlier situation that was skewing the results in Chelmer and the month was removed from the analysis. This is consistent with the previously reported outcomes.

Methodology

Completed analyses

A before and after cohort study was completed for Ardleigh, Chelmer and Peter Bruff, and a before and after study was completed for Hadleigh. Galleywood was used as the control ward for Ardleigh and Chelmer. Basildon Assessment Unit was used as the control ward for Peter Bruff.

The number and severity of self-harm and assaults and bank and agency spend related to 1:1 observations data[17] was compared before (baseline period) and after go-live (post go-live period) to calculate the impact of the Oxehealth system and where appropriate, compared to a control ward.

Spend on bank and agency staff was collected by requesting hours and cost for each instance of bank and agency use. Request reason for additional staff was analysed[18] with 1:1 observation spend being used to measure the impact of the system.

Evaluation period

Ardleigh and Peter Bruff went live in April 2020 and Chelmer and Hadleigh went live in August 2020.

Evaluation periods were chosen to maximise the evaluation period and aligned to the evaluation periods possible for control wards to maintain a fair comparison.

Evaluation period and control ward summary

Active Ward	Baseline period	Post go-live period	Overall period	Control ward
Chelmer	Mar 20 to Jul 20	Aug 20 to Jan 21	• 5-month baseline • 6-month post go-live	**Galleywood** (5-month baseline vs 6-month post go-live)
Ardleigh	Apr 19 to Mar 20	Apr 20 to Jul 21	• 12-month baseline • 16-month post go-live	**Galleywood** (5-month baseline vs 6-month post go-live)
Peter Bruff	Apr 19 to Mar 20	Apr 20 to Jun 21	• 12-month baseline • 15-month post go-live	**Basildon Assessment Unit** (12-month baseline, 15-month post go-live
Hadleigh	Mar 20 to Jul 20	Aug 20 to Jul 21	• 5-month baseline • 12-month post go-live	**No control**

[17] Request reasons considered to be 1:1 observations were: "1:1 nursing", "1-1 Client Observations level 1", "1:1 Client Observations level 2", "1:1 Client Observations level 3" and "Increased Client Observations".

Minimising COVID-19 as a variable

The COVID-19 pandemic is a variable that is likely to impact the data analysed. It is difficult to account for, but attempts have been made by managing evaluation periods.

The evaluation period for Chelmer and Hadleigh begins from March 2020 to help account for the impact of COVID-19.

Ardleigh and Peter Bruff both had go-live dates in April 2020 and therefore the baseline period had to be prior to COVID-19.

Galleywood's go-live date for the Oxehealth system was February 2021 and there was a confounder that reduced Galleywood's incident levels from March 2020 onwards. Therefore, Galleywood's evaluation period was from March 2020 to January 2021. Chelmer had the same evaluation period to have a like-for-like comparison to Galleywood.

Ardleigh is compared to Galleywood in this evaluation, however their evaluation periods are not like-for-like. The reason for this is that Ardleigh's go-live date was April 2020 and Galleywood data could only be used from March 2020. This would only give 1 month of baseline data and therefore is not a sufficient baseline period. In this case, Ardleigh's evaluation period has been maximised instead of being aligned to Galleywood's.

Basildon Assessment Unit's go-live date for the Oxehealth system was July 2021. Therefore, Basildon Assessment Unit's and Peter Bruff's evaluation period was from April 2019 to June 2021.

Hadleigh did not have a control ward and therefore its evaluation period has been maximised.

Data normalisation and extrapolation

The data in each analysis was normalised by Occupied Bed Days (OBDs) to account for variations in occupancy and ward size (i.e. number of bedrooms), and then annualised to determine what the impact would be per year.

The table below outlines the total OBDs for the baseline and post go-live periods across all wards considered in the study.

Ward	Ward size	Baseline occupied bed days	Post go-live occupied bed days
Ardleigh	18	6,662	8,451
Peter Bruff	17	5,938	6,551
Chelmer	16	2,157	2,916
Hadleigh	15	1,720	4,848
Galleywood	18	2,273	3,232
Basildon Assessment Unit	19	7,092	6,653

Outliers treatment

Outliers are data points that differ significantly from other data points and are, by nature, unexpected (i.e. it would not be expected to occur). Therefore, outliers can skew the results of an analysis and make the results less representative of reality.

Incidents were split into 4 categories: assaults across the ward and in bedrooms, and self-harms across the ward and in bedrooms. Potential outliers were identified by looking for patients with a high number of incidents and rate of incidents per day. The rate of incidents (number of incidents /

duration on the ward) for a given category was reviewed for outliers. If the rate surpassed 0.25 incidents per day, the patient was excluded as an outlier. Duration on the ward was estimated as the first and last incident on the ward, in order to calculate the rate of incidents per day.

This identified 10 outliers, which were subsequently removed from the analysis. This resulted in 10 out of 1,297 (0.8% of patients) excluded from the analysis. The breakdown of these 10 outliers was as followed:

- 1 outlier for analysis of assaults incidents (only applicable to ward-level analysis)
- 9 outliers for analysis of self-harm incidents (of which 4 were only applicable to ward-level analysis and 5 were applicable to both ward-level and bedroom analysis)

On Chelmer specifically, August 2020 was considered to be an outlier month for bank and agency spend related to 1:1 observations. There were several patients with a diagnosis of emotionally unstable personality disorder. The acuity on the ward increased due to the combination of these patients and therefore there were 3-4 patients on level 3 observations (i.e. 1:1 observations) throughout August 2020. This was considered to be an outlier situation that was skewing the results in Chelmer and the month was removed from the analysis. This is consistent with the previous reported outcomes.

Confounders treatment

A Ward Manager or Matron was interviewed for each of the active and control wards to identify confounders that could influence the analysis of incidents and 1:1 bank and agency spend.

Topics covered in the interviews included changes to patient demographics and acuity, staffing ratio and mix, clinical governance and policies (including any new clinical or operational initiatives), use of technology and COVID-19.

Limitations

COVID-19 pandemic: the COVID-19 pandemic affected wards in different ways, notably increasing the patient acuity on Ardleigh, Chelmer and Peter Bruff, and turning Basildon Assessment Unit to a red route ward. Patients were required to isolate for at least 7 days upon inpatient admission and significantly more temporary staff were required due to substantive staff illness. The impact of COVID-19 cannot be adjusted for in the analysis but efforts have been made to try to minimise its effect through defining the evaluation periods.

Evaluation time periods: The baseline periods were shortened for Chelmer and Hadleigh to start from March 2020 to help account for the impact of COVID-19. Ardleigh and Peter Bruff both had go-live dates in April 2020 and therefore the baseline period had to be prior to COVID-19. Galleywood's go-live date for the Oxehealth system was February 2021 and there was a confounder that reduced Galleywood's incident levels from March 2020 onwards. Therefore, Galleywood's evaluation period was from March 2020 to January 2021. Chelmer's evaluation period was matched with Galleywood's to have a like-for-like control ward comparison. Ardleigh is compared to Galleywood but its evaluation period could not be aligned to Galleywood's due to the Galleywood baseline period starting in March 2020 (the earliest it could start due to a confounder), which is when Ardleigh went live with the Oxehealth system. Basildon Assessment Unit's go-live date for the Oxehealth system was July 2021. Therefore, Basildon Assessment Unit's and Peter Bruff's evaluation period was from April 2019 to June 2021.

Suitability of control wards: The control wards used were not exactly the same as the active wards they were compared to, but were considered to be sufficiently similar to be compared. The control wards had the same pathway and patient demographic and similar ward design. However, the control wards had lower incident rates and did not state an increase in acuity due to COVID-19. Basildon AU. became a red route ward during the COVID-19 pandemic. This meant that all admissions for Basildon Mental Health Unit and Rochford Hospital were through Basildon AU. Therefore, Basildon AU. had a higher proportion of patients detained under section 2 and 3 of the Mental Health Act 1983. To manage the changes of being a red route ward, support workers increased from 4 in the dayshift and 3 in the nightshift to 14 and 12. Hadleigh did not have a suitable control ward. Therefore, only a before and after comparison could be made to evaluate the impact of the Oxehealth system on Hadleigh.

Adherence to acknowledging the system's impact in incident reporting: Staff were able to record whether the system had helped to identify or support in a potential incident in the incident reporting system. In Ardleigh, Peter Bruff and Chelmer staff were alerted to 37%, 12% and 14% of self-harm in bedrooms respectively, however in Hadleigh there were 0 recorded instances where staff reported that the system had helped to identify or support an incident in the bedroom. When the incident data was reviewed in detail, there were incidents where the system had helped to prevent or act as an early warning sign to a self-harm incident, but it had not been noted in the incident form by staff. This suggests that adherence to acknowledging the system's support in identifying incidents or potential was not 100% and further training is needed to inform staff on how to record incidents alerted by the system.

Statistical significance of the results: A "bootstrapping" methodology was used to determine statistical significance to generate the likelihood of achieving a similar result if the study was conducted again. The patients' data set was resampled several times while replacing one patient from the data set each time. The results in this report were not statistically significant and more data with more patients would be required for statistically significant results.

Appendix

Severity of assaults <u>across the ward</u> (includes bedroom incidents)

Annualised assaults severity across the ward						
Pathway	**Ward**	**Status**	**No / Low[19]**	**Moderate**	**Death / Catastrophic**	**Relative change (%)**
Female Acute	**Ardleigh**	Baseline	90	0	0	N/A
		Post go-live	74	1	0	
	Galleywood	Baseline	66	0	0	
		Post go-live	28	0	0	
Female Acute	**Chelmer**	Baseline	81	0	0	N/A
		Post go-live	42	2	0	
	Galleywood	Baseline	66	0	0	
		Post go-live	28	0	0	
Mixed Assessment	**Peter Bruff**	Baseline	48	1	0	N/A
		Post go-live	61	0	0	
	Basildon AU.	Baseline	40	0	0	
		Post go-live	54	3	0	
Mixed PICU	**Hadleigh**	Baseline	45	0	0	N/A
		Post go-live	71	1	0	

Severity of assaults <u>in the bedroom only</u>

Annualised assaults severity in bedrooms						
Pathway	**Ward**	**Status**	**No / Low**	**Moderate**	**Death / Catastrophic**	**Relative change (%)**
Female Acute	**Ardleigh**	Baseline	8	0	0	N/A
		Post go-live	6	0	0	
	Galleywood	Baseline	14	0	0	
		Post go-live	10	0	0	
Female Acute	**Chelmer**	Baseline	6	0	0	N/A
		Post go-live	5	0	0	
	Galleywood	Baseline	12	0	0	
		Post go-live	10	0	0	
Mixed Assessment	**Peter Bruff**	Baseline	4	0	0	N/A
		Post go-live	28	0	0	
	Basildon AU.	Baseline	8	0	0	
		Post go-live	28	0	0	
Mixed PICU	**Hadleigh**	Baseline	32	0	0	N/A
		Post go-live	39	0	0	

19

Severity of self-harm in the bedroom only

Annualised self-harm severity in bedrooms						
Pathway	**Ward**	**Status**	**No / Low**	**Moderate**	**Death / Catastrophic**	**Relative change (%)**
Female Acute	**Ardleigh**	Baseline	131	0	0	N/A
		Post go-live	124	0	0	
	Galleywood	Baseline	9	0	0	
		Post go-live	26	0	0	
Female Acute	**Chelmer**	Baseline	113	0	0	N/A
		Post go-live	101	0	0	
	Galleywood	Baseline	9	0	0	
		Post go-live	26	0	0	
Mixed Assessment	**Peter Bruff**	Baseline	109	0	0	N/A
		Post go-live	135	0	0	
	Basildon AU.	Baseline	28	0	0	
		Post go-live	62	1	0	
Mixed PICU	**Hadleigh**	Baseline	64	0	0	N/A
		Post go-live	24	0	0	

Assault related A&E visits across the ward

Annualised assault related A&E visits across the ward					
Pathways	**Ward**	**Baseline**	**Post-go live**	**Change (%)**	**Relative change (%)**
Female acute	**Ardleigh**	**0**	**4**	**100%**	N/A
	Galleywood	0	2	100%	
Mixed Assessment	**Peter Bruff**	**2**	**1**	**-55%**	163%
	Basildon AU.	4	1	-72%	
Female acute	**Chelmer**	**0**	**4**	**100%**	N/A
	Galleywood	0	2	100%	
Mixed PICU	**Hadleigh**	**0**	**3**	**100%**	N/A

Responses on incident forms mentioning Oxevision across the ward

Alerted by Oxevision field responses (Annualised)					
Ward	**Pathway**	**Total Bedroom incidents**	**Yes**	**No**	**Blank**
Ardleigh	Acute	353	8553%	194	7376%

Chelmer	Acute	260	2403%	150	8612%
Peter Bruff	M. Assessment	668	2175%	485	16167%
Hadleigh	PICU	106	0%	79	2701%

Annualised 1:1 bank and agency spend <u>across the ward</u> (control wards only)

1:1 Bank & Agency spend (Annualised)					
Pathway	**Ward**	**Baseline**	**Post go-live**	**Change (%)**	**Saving (£)**
Female Acute	Galleywood	£119,025	£11,186	**-91%**	£107,839
Mixed Assessment	Basildon	£20,215	£74,342	**268%**	-£54,127
	Total	£139,240	£85,528	**-39%**	**-£53,712**