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Two years of unintended consequences: introducing an electronic health record system in a hospice in Scotland

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Abstract

Aims and objectives

The aim of the study was to explore the impact of implementing an electronic health record system on staff at a Scottish hospice.

Background

Electronic health records are broadly considered preferable to paper based systems. However, changing from one system to the other is difficult. This study analysed the impact of this change in a Scottish hospice.

Design

Naturalistic prospective repeated measures mixed methods approach.

Method

Data on the usability of the system, staff engagement and staff experience were obtained at four time points spanning 30 months from inception. Quantitative data were obtained from surveys, qualitative from Concurrent Analysis of free text comments and focus group. Participants were all 150 employees of a single hospice in Scotland.

Results

Both system usability and staff engagement scores decreased for the first two years before recovering at 30 months. Staff experience data pointed to two main challenges:

1. Technical issues, with subthemes of accessibility and usability.
2. Cultural issues, with subthemes of time, teamwork, care provision and perception of change.

Conclusion

It took 30 months for system usability and staff engagement scores to rise, after falling significantly for the first two years. The unintended outcomes of implementation included challenges to the way the patient story was both recorded and communicated. Nevertheless this process of change was found to be consistent with the 'J curve' theory of organizational change, and as such is both predictable and manageable for other organizations.

Relevance to practice

It is known that implementing an electronic health record system is complex. This paper puts parameters on this complexity by defining both the nature of the complexity ('J' curve) and the time taken for the

organisation to begin recovery from the challenges (two years).

Understanding these parameters will help health organisations across the world plan more strategically.

Key words

Caring, Computerised, Health Services Research, Implementation, Nursing Information Systems, Nursing Workforce, Organisational Behaviour, Palliative Care, Technology

What does this paper contribute to the wider global clinical community?

- Health services across the world are increasingly turning to electronic health records instead of paper records. The benefits of electronic records are well understood, but the process of change less so, with unintended consequences common.
- This paper shows that changing systems from paper to electronic impacted not only on the way that care was recorded, but also on organizational culture more widely. There is, therefore, a significant risk that staff can disengage with the organization if the transition is not managed well. Disengagement is associated with poorer care.

- Managing the process well requires a deep understanding of it. Whilst the technical challenges are reasonably well understood, what was less expected was the challenge to nursing identity revealed here, and the amount of time needed for resolution. The most straightforward recommendation is that implementers should understand these findings and that clinical staff should be involved at the earliest possible opportunity and throughout the transition process.

Introduction

Electronic health records (EHR) improve the quality of information stored by practitioners according to Clarke et al. (2013). They are seen as preferable to paper based systems (Fritz et al. 2012) and the trend worldwide is to move away from paper towards EHR. As a consequence, there is considerable interest in the best way to manage this change (Ratwani et al. 2015). Poorly managed change has been shown to impact negatively on staff experience, which in turn impacts on patient care (Van Bogaert et al. 2013). By contrast, positive staff experience of change is associated with organizational success (Shum, Bove, and Auh 2008, Snowden and MacArthur, 2014). Whilst there have been previous studies examining the impact of implementation of EHR on physicians (Hanauer et al. 2016), and qualitative explorations of the impact on nurses

(Gephart et al, 2015), as far as we know this is the first prospective mixed methods longitudinal study examining the impact of implementation of EHR on all staff within a single organization; a hospice in Scotland.

Background

Electronic health records are highly likely to replace paper records at some point in the near future. The National Health Service (NHS) in the UK, for example, hopes to become entirely paperless by 2018 (Department of Health 2013). Adoption of EHR tripled in US between 2009-2015 (Gephart et al., 2015). Amongst the putative benefits of this shift are better organization, more consistent recording and easier access to relevant information (Cho et al., 2016). EHRs improved the quality of notes according to a large study by Burke et al. (2015). Because patients should not have to repeat routine information EHRs should therefore improve both cost effectiveness and the patient experience (Boonstra, Versluis, and Vos 2014).

However, as described by Ober and Applegate (2015) there are often unintended consequences of large IT projects designed to streamline systems. In the case of implementing EHRs these include technical issues that may detrimentally impact on patient care (Bowman 2013). In some

cases patient safety has been compromised by poorly planned implementation (Kaplan and Harris-Salamone 2009). Ethical issues arise over who should have access to information (Brisson et al. 2015), and how secure the data may be within the record (Ozair et al. 2015). Professional cultural issues emerge from the challenge to the way each health discipline has historically recorded and communicated the patient story within health records (Struck 2013). Many commentators suggest the patient has become lost in the transition to EHR (eg see Ober and Applegate 2015; Varpio et al., 2015).

According to Gephart et al., (2015), unintended consequences of EHRs for nursing include unexpected changes to work patterns and difficulty accessing necessary information. This has the potential to impact on staff engagement more generally. However despite these issues none of the nurses in their review would have chosen to revert back to paper records. This is consistent with King et al.'s (2014) finding that the longer the time clinicians in their study had used EHRs the more favourably they viewed them.

Adopting EHR is therefore not just inevitable but also appears preferable to its adoptees. However, moving from one to the other is much more complex than many planners seem to realize. It involves not just a change to a different method of note keeping but a fundamental change

to the way care is organised, recorded and communicated. It impacts upon staff experience and engagement, often in unexpected ways (Gephart et al., 2015). In order to better understand the parameters of this process this study used a mixed methods longitudinal design to examine the impact on staff of implementing a new EHR in a hospice in Scotland.

Theoretical framework

The underpinning theory of change used in this study is the 'S-shaped curve' (Murre 2014) of implementation take-up. This theory, first described in the context of adoption of new innovations by Rogers (1962) states that the growth curve of people adopting a new technology is often S shaped. Early on in the implementation take-up is low. Later, take-up accelerates until the majority of the population has adopted it, leaving only a small proportion still resisting the change (Figure 1). In general, social processes of change always exhibit some type of 'learning curve' (Gersick 1991). The S curve is arguably the most useful representation in relation to organizational change, and it has been successfully used in studies similar to the one proposed here (Nikula et al. 2010). The theoretical function of this paper is, therefore, to examine if the S curve explains any observable change, and if so, what its parameters may be, such as timeframe.

Figure 1. S-shaped curve of innovation adoption

Electronic health record and the study hospice

Crosscare is the electronic health record system (Clarke et al., 2013) discussed in this paper. Crosscare is designed specifically for the hospice market, and is currently used by over 70 hospices in UK¹. It was introduced into the study hospice in 2013 as a replacement for their paper-based system. The study hospice serves an area of over 1,300 square miles and a population of almost 370,000 people. It provides specialist palliative care to people with life-limiting illnesses, irrespective of their diagnosis, their proximity to death, or socio-economic background. A specialist multi-professional team cares for people with complex physical or psychological needs. This care provision comprises inpatient and day services and extends to the community, e.g. people's own homes, hospitals or care homes. Fifty percent of the 225 admissions to the inpatient unit in 2015 were discharged following a period of symptom management or to their preferred place of death. Average stay was 22 days. That year, over 2500 day service places were allocated and more than 4000 visits to patients in the community were logged not including hospital palliative care team visits which exceeded 2700. In

¹ <https://www.oneadvanced.com/products/crosscare/>

2015, this hospice had over 190 staff and almost 700 volunteers, who were part of this large service, which is free for the service users.

Aim

Explore the impact of implementing an electronic health record system on staff at a Scottish hospice.

Objectives were to describe change over 30 months in:

1. System usability,
2. Staff engagement at the hospice, and
3. Staff experience of the system.

The research questions therefore entailed the following hypotheses:

1. Crosscare would become more usable over time.
2. Staff engagement would remain constant over time.

In order to meet the third objective and contextualise these hypotheses, the social process of implementation was simultaneously explored by qualitatively examining staff experience of the system throughout the study period.

Method

The evaluation used a naturalistic prospective repeated measures mixed methods approach.

Design

A survey was sent to all hospice staff at four time points as illustrated in figure 2. It was administered as an online survey via email invite. A multi-professional focus group with 12 participants was also conducted between the first and second survey. The survey contained the System Usability Scale, and measures of staff engagement and staff experience. These measures are detailed below.

Figure 2. Study timeline here

Data Collection

System Usability

The System Usability Scale (SUS) is a 10-item tool designed to measure the usability of a system. It has been extensively validated and translated into various languages (Dianat, Ghanbari, and Asghari Jafarabadi, 2014). Whilst there are claims that the SUS measures two factors, 'usable' and 'learnable' (Lewis and Sauro, 2009), the majority of the psychometric literature considers the SUS to represent a single construct of usability (Bangor, Kortum, and Miller, 2008; Sauro, 2011). It has been used in other studies to examine the usability of electronic health records (Clarke et al., 2014) as well as new electronic search systems in libraries (Comeaux, 2012). The reason for using it here was to obtain a valid generalisable measure of how practically comfortable the staff were with the new technology.

Staff Engagement

Staff engagement is the '*individual's involvement and satisfaction with and enthusiasm for work*' (Harter et al., 2002). Engagement is associated with strong leadership, improved outcomes and can mitigate burnout (Van Bogaert et al., 2013). Where staff are engaged, organisational performance is improved and where staff are disengaged, care fails (Francis, 2013). Engagement was chosen as an important variable here

because a relationship was expected between the usability of the system and staff engagement. If this were true, then future implementers could better understand any such relationship and factor in any likely impact on staff engagement.

The following item was used to measure staff engagement:

Overall, my experience with my organisation is: 0 = Poor to 10 = Excellent.

This item was chosen because of its simplicity, brevity and validity. It has been shown elsewhere that responses to this item correlated very strongly with mean responses to a longer validated measure of staff engagement in health services (Snowden, Reilly, and MacArthur, 2014). It should, therefore, operate as a short proxy measure of staff engagement. A short measure was considered essential in order to keep participant burden to a minimum, especially as the survey was repeated four times and so continued engagement with the surveys was considered paramount.

Staff Experience

Staff experience with the new system was explored to develop a contextual explanation for any change in usability or staff engagement.

The two measures above, for example, may show that participants are engaged and find the system usable, but these data alone lack explanatory depth. Likewise, a participant may find the system highly usable, but also be disengaged with the organisation. Uncovering reasons for anomalies such as this would allow for a deeper, more contextual understanding of the social process underpinning the implementation.

Staff experience with Crosscare was obtained by concurrently analyzing (Snowden and Martin 2010) free text comments in the four surveys with responses in the focus group. The free text item was worded as follows:

Finally, in the text box below please write any other comments you wish to make. The box will expand as you type.

The focus group was conducted using the semi-structured schedule below. Where interesting asides were made during the group, the leads were followed iteratively. All data were transcribed verbatim and imported into NVivo10 for further analysis.

Table 1. Focus group schedule

Study Participants

All members of employed clinical and non-clinical staff that used Crosscare were invited to participate. This entailed 119 members of staff at baseline in Nov 2013, 123 in June 2014, 133 in November 2014, and 127 staff in April 2016.

Ethics

Permission to undertake the study was given by University of the West of Scotland university ethics committee in 2013. The survey was sent to all hospice staff via email from one of the authors (HK). A consent form and information sheet detailing the purpose of the study preceded each online survey, with participants clicking a consent box to assent to their data being used anonymously. For the focus group consent was also taken and assurances given by the research team that no identifying data would be either requested or used in subsequent publications. Participants had volunteered for the focus group via an invite contained within the first online survey.

Analytic plan

1. Crosscare would become more usable over time

Normality tests were run to establish whether parametric or non-parametric tests could be used on the scores for the system usability scale. Mean/median scores at the four data collection points were then compared.

2. Staff engagement overall would remain constant over time.

Normality tests were run to establish whether parametric or non-parametric tests could be used on the scores for staff engagement. Mean/median scores at the four data collection points were then compared.

3. Qualitative analysis of staff experience of using Crosscare over time.

Concurrent Analysis (Snowden and Martin 2010) was used to analyse the staff experience of using Crosscare. In brief, Concurrent Analysis involves four stages:

1. The gathering and transcription of all relevant primary data.
2. Line by line coding of the data focusing on gerunds.
3. Identification of connections between codes.
4. Thematic grouping of connections to explain the whole as a social process.

The rationale for using Concurrent Analysis was that it treats all narrative data as conceptually equivalent. This is an important consideration when combining different sources of qualitative data such as written and verbal as obtained here. It has historically been used to analyse primary narrative data alongside comparable secondary narrative data, usually taken from the literature (Hollins-Martin et al, 2012; Snowden et al. 2011). In this study it was used to simultaneously analyse different *types* of primary data. This is acceptable where the data is all gathered to focus on the same social process. The focus of the analysis is on action taken by participants. Its underpinning philosophy is coherence (Thagard 2000), such that it prioritises connections between codes as a method for explaining social processes. For a detailed description of the philosophy please see Snowden and Atkinson (2012). This analysis was undertaken by HK and AS.

Results

At baseline, 55 staff completed the survey. The second survey was completed by 48 and the third survey by 36 staff. The final survey was completed by 55 participants. Breakdown by profession is in table 2.

Table 2. Respondents at each point

Respondents completed all numerical elements on all surveys. Mean (SD) system usability scores out of 100 were 54.51 (18.2) at baseline, 52.33 (15.11) at second, 47.11 (14.07) on third, and 65.3 (15.6) at final survey (figure 3). Mean (SD) experience (out of 10) was 7.78 (1.64) at baseline, 6.76 (1.791) at second, 5.91 (2.78) on third, and 6.03 (1.8) at final survey (figure 5).

In relation to the textual data a total of 85 free text comments were made across all four surveys. In addition to this, twelve participants attended the focus group: four inpatient nurses, two community nurses, two day patient nurses, one other clinician, a chaplain, one administrator and one social worker. Examples from the raw data are given in table 3. The focus group map, containing key contributions by participants and notes by the lead researcher, is in the anonymised supplementary file titled 'focus group map'.

Analysis

1. Crosscare would become more usable over time

As can be seen from figure 3, this did happen eventually, following a significant decline over the first three measurements.

Figure 3. System Usability Scale: mean Scores

There were no outliers and each sample was normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p=.227$). A one-way ANOVA was run in SPSS version 20. System usability scores were found to be significantly different at different time-points $F(3, 187) = 10.83, p < .0001$.

It is important to note that SUS scores are not linear. This means the effect size of this difference needs to be interpreted with caution. Relative scores follow the S-shaped curve broadly equivalent to the one discussed earlier Rogers (1962), and so SUS scores are more meaningfully understood as percentiles (figure 4). This means that baseline SUS scores were around the 18th percentile and then declined further into the bottom

ten percent at time-point three (47.11 equates to approximately 10th percentile, see figure 4), before recovering considerably to above the 40th percentile at final data collection.

Figure 4. Percentile Ranks for SUS scores

2. Staff engagement overall would remain constant over time.

As with the system usability result in hypothesis 1, staff experience of their organisation in this sample decreased over the first three time-points, before increasing at final measurement.

There were four outliers on the third sample, but these values were retained for analysis, as they were conceptually consistent with the free text comments of the participants. Three of four samples were not normally distributed as assessed by Shapiro-Wilk's test ($p < .05$) and, therefore, a non-parametric test was used to test this hypothesis. A Kruskal-Wallis H test was run in SPSS version 20 to determine whether there were differences in mean rank staff engagement scores over time. Mean rank staff engagement scores were found to be significantly different at different time-points $H(3) = 24.65, p < .0001$.

Figure 5. Boxplot showing different median Staff Engagement scores at all four time-points

Analysis of staff experience over time.

Figure 6. Thematic analysis of textual data

Two major themes emerged from the Concurrent Analysis. Firstly, participants remarked on technical issues, grouped into the subthemes of accessibility or usability of the computerised documentation system. These subthemes were closely connected but distinct. Secondly, participants discussed the impact the system had on cultural aspects of the organisation. Subthemes were time, teamwork, care provision and the impact of change (Figure 6). Again, these were closely connected and impacted upon each other. Table 3 illustrates verbatim quotes categorised by theme and subtheme and labelled according to profession and whether the quote was from one of the four questionnaires (labelled as 1-4 after each quote) or an excerpt from the focus group (labelled F). The next section explains the themes and their relationships to each other and ends with a summary of the key changes noted over time.

Technical issues

Accessibility and Usability

Remote and multiple simultaneous user access of records are cited as one of the particular advantages of electronic health record systems (Department of Health, 2013). However, technical problems prevented this in this study, most acutely but not solely experienced by specialist palliative care nurses working in the community (table 3). In short, there were significant technical problems for many staff in just accessing the system or the correct component of the system. Usability was obviously a function of accessibility but specifically refers to issues once the system had been accessed. Opinions were divided regarding usability of the system. While some non-clinical staff commented positively, nurses struggled with readability and navigation, and these problems persisted. Clinical staff highlighted a lack of technical competence impacting on usability, but by the final questionnaire there was evidence that some had begun to find the system both more accessible and usable.

Cultural issues

Time, team, care and change

There was no consensus as to whether using Crosscare saved time. Ward clinical staff felt rather that it was time consuming, and these concerns persisted to final data collection. As with usability admin staff felt it improved efficiency. More subtly, there were claims from the clinical staff that verbal team communication had suffered as a consequence of Crosscare because of the time and energy spent learning the new technology. Interestingly, the inpatient nursing team developed new strategies in order to give each other protected time for documentation, suggesting that the team still worked as a unit in order to support each other, but not necessarily in the way it would have chosen to.

The issue of care was the most prolific subtheme and persisted as a major concern to the last data collection point. Most comments were about the impact of the new system on the way it had affected the ability of palliative care staff to engage with their patients and families. There was considerable anxiety that the 'core business' of hospice care was being challenged, resulting in many staff saying that they had to work extra hours to complete their documentation on top of what they considered their primary job to entail. So, although change was recognised as

inevitable and mainly positive by all, staff voiced the fear that key elements of palliative care, as they saw it, were being lost (table 3).

These cultural issues will be examined in more detail in the discussion section of this paper.

Table 3 here

Overall Impact over time

There was evidence of change over time in the qualitative data, which goes some way to explaining the quantitative findings. Adapting to the new system took time, and more so for some than others. While in the first questionnaire comments were almost solely negative about Crosscare, participants commented more positively in the focus group and second questionnaire, with clinical staff as well as administrative staff verbalising the advantages of a computerised documentation system.

"I find it extremely useful ... can get a wealth of useful information to help us build a picture of the person before meeting them, this helps us understand the person better and support them better. Also when dealing with patients in the inpatient unit it is invaluable

to have access to these notes in our own office prior to visiting the patient, and being in the other building would have found it very difficult otherwise had we had to go and access paper notes.” (AHP; 2)

“...everybody can access them at anytime - previously notes could be "out" ...for up to a week. You can see immediately who has written the entry, it's dated and timed and it is possible to understand the writing.” (Admin staff; 2)

More of the clinical staff became more comfortable with the system over time:

“Over the last 12 months I have found Crosscare a lot easier to use and find it less obstructive and cumbersome.” (Nurse; 4)

This begins to explain the improvement in SUS scores as noted in the final survey. Despite this however, it is fair to say that on balance the staff voiced concerns about technical issues that persisted throughout the study period. Anxieties around issues of time, teamwork, care provision and change remained largely unaltered for the majority of the staff that

voiced an opinion. Thirty months into its implementation Crosscare was still a source of distress to many clinical staff.

Discussion

The quantitative data showed that Crosscare usability was poor to begin with and then declined even further to levels in the bottom eighth percentile of the system usability scale (Bangor, Kortum, and Miller 2008), meaning that staff really struggled with implementing the new system for the first two years. Scores then rose substantially to the 40th percentile suggesting that usability of the system improved for some staff after 30 months.

Staff engagement scores also followed this trend with an improvement, albeit much weaker, at final measure. This offers further support to the conclusion that this was a difficult time for staff. However, to put this in context, supplementary data from a large study of NHS Scotland employees (N=1280) showed mean (SD) scores to the staff engagement measure as 3.65 (2.1) (Snowden and MacArthur, 2014). More data is needed to understand population norms to this item, but it must be recognized that at all time-points the hospice staff group scored at least one standard deviation higher than the NHS employee mean, suggesting that levels of engagement at the hospice were comparatively healthy throughout the whole study period.

In the final survey one respondent explicitly dissociated their experience of Crosscare from their experience of working in the hospice, stating in the free text comments that their staff engagement score (high) was not related to their experience of Crosscare (low). As stated in the beginning of this paper, this is why free text data was sought on experience in order to better understand the relationship between staff engagement and implementation of Crosscare. Certainly the implementation of Crosscare was only one of many changes to working conditions experienced by the staff over the study period, and so the results discussed here cannot be understood in isolation. Furthermore, there was clearly a sense from a group of the staff that they would continue to support the hospice and all it stood for, regardless of any change. Nevertheless, there was a clear correlation between the scores for system usability and staff experience. As one score went down so did the other, and vice versa. It is reasonable to conclude that at a population level the two measures were connected.

In order to provide a theoretical explanation for the impact and evolution of implementation, the S-shaped curve (Rogers, 1962) was not useful in this case. This is because the S-shaped curve only represents growth. The theory failed to account for the period *before* SUS scores began to rise. The first three measures indicated a *decline* in usability. To represent this on the S-curve (figure 1) there would need to be a dip prior to the beginning of the current model. As it is the model doesn't take into

account any representation of *disengagement*. So, whilst patterns of uptake may follow a reasonably predictable path once uptake starts, it is this first period of usability *decline* that warrants further theoretical explanation.

This period of decline is better theorized within the 'J-curve' literature (Hanauer et al. 2016). The J curve predicts a period of decline prior to improvement. Hanauer et al (2016) hypothesised that the J curve would explain adoption of a new electronic health record in their longitudinal study. Interestingly they found that this theory also failed to account for their data. Instead they found satisfaction dropped off on every measure and did not return back to baseline by 25 months. However, whilst the J curve failed to explain their data it appears to offer a better explanation for ours. That is, by 30 months the measures in our study showed signs of increasing above baseline. Perhaps if Hanauer et al had continued their study into year three they may have seen a positive change. This is unknown, but it is interesting that Hanauer et al's results are consistent with ours up to the point where they stopped measuring. Taken together they suggest that at least two years of decreased satisfaction and usability could be expected and planned for in implementing a new electronic health record. Burke et al (2015) offer further evidence of change requiring a longer-term perspective. They examined impact over five and a half years and their conclusion is one of the most positive endorsements of EHRs in the literature.

This claim needs further investigation and corroborating studies. Meanwhile in order to better understand the specific issues raised in relation to satisfaction and usability in this study, the next section integrates the findings into the wider literature on EHR implementation. For consistency it is structured around the technical and cultural themes emerging from the textual analysis (Figure 6).

Technical issues

The benefits of EHR were introduced in the opening section of this paper. In addition the literature states that computer technology in health care has the potential to improve quality of care provision and communication (McCullough et al. 2010) by facilitating exchange of information among the clinicians and thus improving care coordination (Plovnick, 2010). Practical benefits are cited as legibility of entries and remote access of records, which is especially valuable for staff working in the community. It also allows multiple simultaneous user access and lowers the risk of transcription errors (Siegler and Adelman, 2009). As stated the hope is that electronic health records will help save time, meaning more time spent with patients and potential savings of billions (Department of Health, 2013).

In this study the staff appreciated these aspirations. However, enthusiasm was initially dampened by the perception that Crosscare was technically difficult for many. Issues with readability were repeatedly raised. In order to enter clinical notes for patients with multiple problems the completion of multiple templates was required which was time consuming rather than saving. It is well understood (eg Scott et al., 2005) that dissatisfaction can spiral into resistance in such cases. Ratwani et al. (2015) make the similar point that user satisfaction is dependent on a product that meets the needs of the clinicians for their particular clinical environment. Ratwani et al recommended that electronic record providers work very closely with users to understand workflow before implementation. These comments chime very closely with Shimogawa et al's (2012) thesis.

Clinical staff in the inpatient unit and nurses in all areas felt that this input was lacking in the design phase. Badly designed user interfaces are known to have negative impact on system usability (Siegler and Adelman, 2009). This can be mitigated to an extent by good IT training and support (Oroviogicoechea et al., 2010), which has shown to be associated with positive attitudes toward the electronic health record system (Burke et al. 2015). The survey results showed that system usability eventually improved and this can, therefore, be interpreted as a function of consistent ongoing support, but perhaps the problems could have been

mitigated with more staff engagement and hence better user-centred design in the first place (Ratwani et al., 2015).

Cultural issues

There was evidence that staff working in non-clinical roles and some allied health professionals (AHP) were able to benefit from data sharing and ease of accessibility. However, in line with Chow et al. (2012), others (mainly medical and nursing staff) did not find that they gained more time for patient care or that they worked more efficiently. The data showed rather that time wasting was frequently mentioned as a function of Crosscare. Reduced productivity, additional work and loss of time through lengthy navigation through the system have long been understood as potential issues with EHRs (Scott et al., 2005).

Changing to Crosscare impacted heavily on work processes beyond simply changing the way people entered notes. Participants described significant changes in team dynamics and the way the team worked. While it is always difficult to generalize from a small study, it is fair to say that the impact on team dynamics should be prepared for, as these are common themes in the literature exploring theories of change management more widely (Mitchell 2013; Pollack 2015).

In direct contrast to government aspirations (Department of Health, 2013), electronic record keeping has been seen by some as obstructive to frontline care delivery (Bowman 2013). Plovnick (2010) observed, for example, that using computer technology reduces eye contact with patients, and can, therefore, be perceived as detrimental to the therapeutic relationship. This was mentioned in the free text here. In more practical terms, participants complained that they could not achieve the same amount or quality of work as before or had to work overtime to manage the workload. Some went as far as suggesting documentation superseded care. Siegler and Adelman (2009) suggested that data is often accumulated for the purpose of reducing litigation risk instead of for the improvement of care. This is consistent with comments about documentation superseding care, where clinicians perceived themselves to be inputting superfluous information.

This issue of notes being 'fit for purpose' has been further discussed by Hirschtick (2012), who claims that electronic health record systems lose the narrative quality of events 'as they occur', and as they would have been documented in pre-electronic documentation. This suggests a cultural attachment to a certain style of note writing that may not be accommodated by the new system (Ober and Applegate 2015). Nurses in this study spoke of the patient story being somehow diminished, a finding consistent with Varpio et al. (2015).

If this is true then nurses are not just learning the technical elements of a new record keeping system, but more significantly they are having to find new ways to reconstruct the narratives they have been using all their careers to communicate the patient story. It is interesting to note that this narrative method of note writing fails to communicate effectively, even in EHRs, and so some sort of challenge to it is welcome (Finn 2015). Nevertheless, moving away from a style of note writing that has a very long history goes some way towards explaining the long delay in nurses finding the new system useful. Narrative analysts believe that cultural attachment to a certain style of narrative is at the core of how people make sense of their worlds (McAdams and McLean 2013). Changing this narrative is difficult (Festinger 1957).

Change over time

It took over two years from implementation for system usability scores to rise above baseline, suggesting that future planners should be ready for considerable upheaval if considering major change to routine methods of recording practice. Likewise, staff engagement scores dropped significantly over the same period and only on final measurement showed signs that recovery may be under way. It cannot be claimed that the implementation of Crosscare caused the change in staff engagement scores. Many other changes were happening within the hospice at the same time. However, the SUS scores and the engagement scores were

positively correlated, and so it remains fair to assume that the organisational implementation of Crosscare was a factor in the reduction of staff engagement scores.

It has been understood for a long time (Lorenzi and Riley, 2000) that even the best systems can fail if the users are resistant to change. There is a tendency for managers to mistakenly assume that technology will be implemented when it is installed; yet this rarely happens in practice (Holden and Karsh 2010). This study found that the implementation of Crosscare into the hospice was challenging, both technically and culturally, but also consistent with the literature on implementing similar projects worldwide (Sherer, Meyerhoefer, and Peng 2016). As such they are open to evidence based recommendations (Boonstra, Versluis, and Vos 2014).

The clearest technical point was that users found the interface difficult to understand and navigate, especially at the beginning. This could have been mitigated with more user involvement in the design phase (Ratwani et al., 2015). Enough computer terminals and ergonomic work conditions should be in place. Close and effective IT support should be available to quickly resolve hardware and software problems (Chow et al., 2012). Managers should plan to support staff training requirements, including the restructuring of work processes to accommodate the different nature of

the documentation (Siegler and Adelman, 2009). As discussed above, this can entail a considerable culture shift, incorporating not just a technical challenge but a cultural one too, with all the associated anxiety that brings (Cho et al. 2016). Current literature including this study suggests this process takes at least two years (Hanauer et al. 2016).

The key recommendation is therefore for managers to understand the complexity of the change in order to support a realistic implementation strategy. Strong leadership is required to promote psychological ownership ("buy-in") in staff during the implementation period and prevent a counter-climate of conflict. This leadership is much more likely to succeed if the leader understands the technical and cultural elements discussed here.

Strengths and limitations

This was a prospective longitudinal study designed specifically to investigate the implementation of a new electronic system over its first 30 months. The strength of this design is that there is less reliance on recall as in comparable retrospective studies (Hassan, 2005). This study is, therefore, a robust representation of the usability of the system and staff engagement as it was at these time points. Nevertheless, it was a small study, conducted in one hospice and, therefore, not possible to generalise

to other organisations. The response rate was adequate but not excellent, and it remains unknown what the people who did not participate thought of the development. Furthermore, in an ideal study the quantitative data would have been paired, so more detailed statistical analyses could have been undertaken, such as examination of individual differences over time. However, paired data would have had to be at the expense of anonymity and the latter was considered more important, so people felt they could speak as freely as possible and contribute to the study.

In regard to the instruments used, the System Usability Scale is a widely validated measure with a great deal of completions across a range of contexts, allowing the user to realistically compare the usability of one system to another (figure 4). This is a strength of the study. However, the study used just one measure of staff engagement, a short analogue item taken from a 28-item scale. This is acknowledged as a weakness. Despite there being a very strong correlation between total scores to the full engagement survey and this analogue item (Snowden & MacArthur, 2014), it is not known if this relationship holds if participants only complete the analogue measure. This requires further research, but the decision to use the measure was a pragmatic one, based on reducing participant burden and keeping the survey as brief as possible. The first survey had included the full measure and uptake dropped off considerably in the second and third survey, whereas it increased notably in the last survey where participants were aware that just the analogue item was being used.

The free text comments added an important qualitative element to the research. However, these data must also be interpreted with caution. The free text was attached to the end of questionnaires and was, therefore, possibly perceived to be superfluous by the participants if they felt that their opinion was sufficiently expressed already. Perhaps only those who felt strongly about the subject or were not under time pressure voiced their opinion.

Also, although the findings tie in with the literature, there is also a possibility of response bias, as despite the assurance of anonymity staff members might have had concerns about their answers being identified. It is worth noting that the equal largest sample of respondents to the survey was at the end of the study, which implies participants had been comfortable with the author's trustworthiness throughout. As discussed above, however, this could simply have been an artifact of knowing that the final questionnaire was brief. Lastly, researcher bias regarding data interpretation cannot be ruled out as the research nurse also worked as a staff nurse in the hospice. However, this was mitigated as far as possible by the two authors independently analysing the free text using a robust methodology and agreeing on interpretation.

Conclusion and relevance to clinical practice

Implementing a new electronic health record system was found to be technically difficult and culturally complex. Implementation theories suggest that the rate of uptake of new technology is reasonably predictable and for this study the J-curve explanation best fitted the data. It predicted the period of disengagement found in this study. Consistent with the wider literature it appears that implementing EHRs takes at least two years.

Along with quantifying this period the key contribution of this paper was to illuminate the significant *cultural* impact the implementation had on the delivery of care. The new electronic system challenged nurses in particular to document care in different ways. This led to significant changes in teamwork and some nurses feeling the patient story had been lost.

The most practical recommendation is, therefore, for nurse managers to understand both the timeframes involved and this likely challenge to nursing identity. It is already known that managers should involve staff at the earliest possible opportunity in the technical design and rollout of the system. In addition however they should also be sensitive to the way nurses have historically documented care. They should use this

understanding to facilitate collaborative discussions on how best to represent the patient story in the new system, at the same time bearing in mind the wider clinical function of the record to communicate effectively to all. The likely impact of this deeper approach will be to make the system fit for purpose whilst simultaneously lessening the time taken to implement the change.

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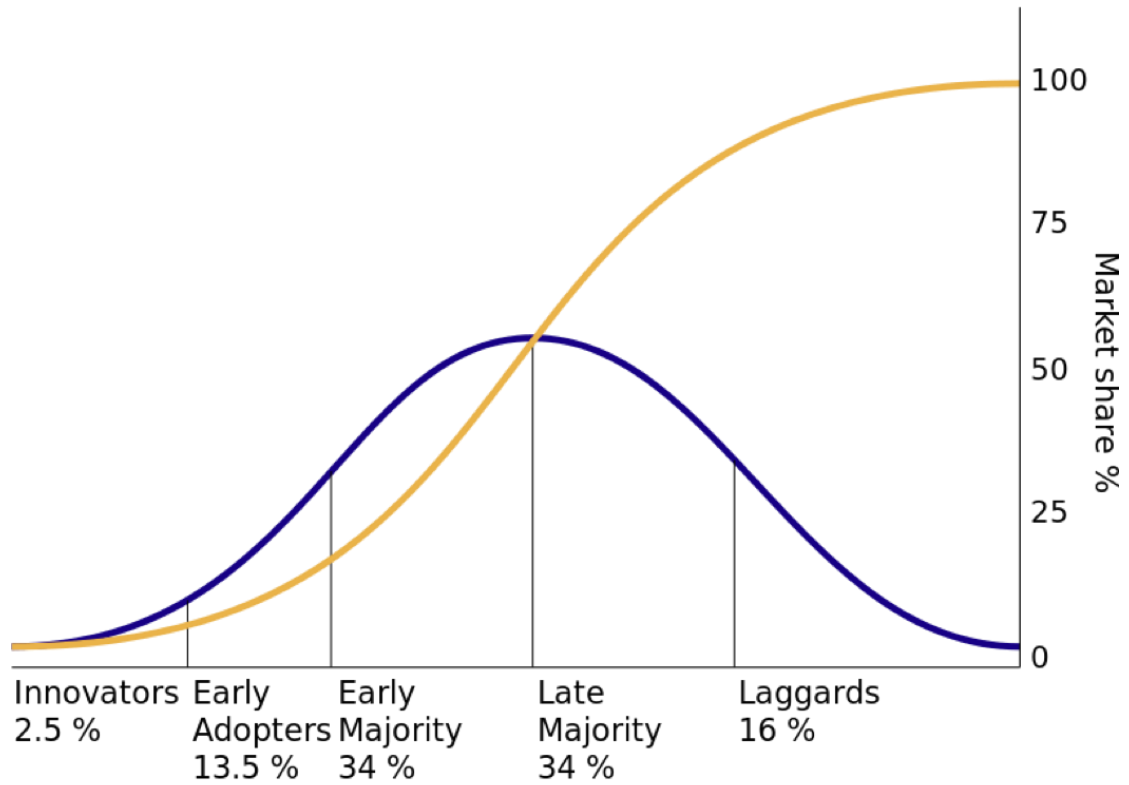


Figure 1. Roger's (1962) S-Shaped theory of innovation adoption

(https://en.wikipedia.org/wiki/Diffusion_of_innovations#/media/File:Diffusion_of_ideas.svg public domain)



Figure 2. Data gathering timeline

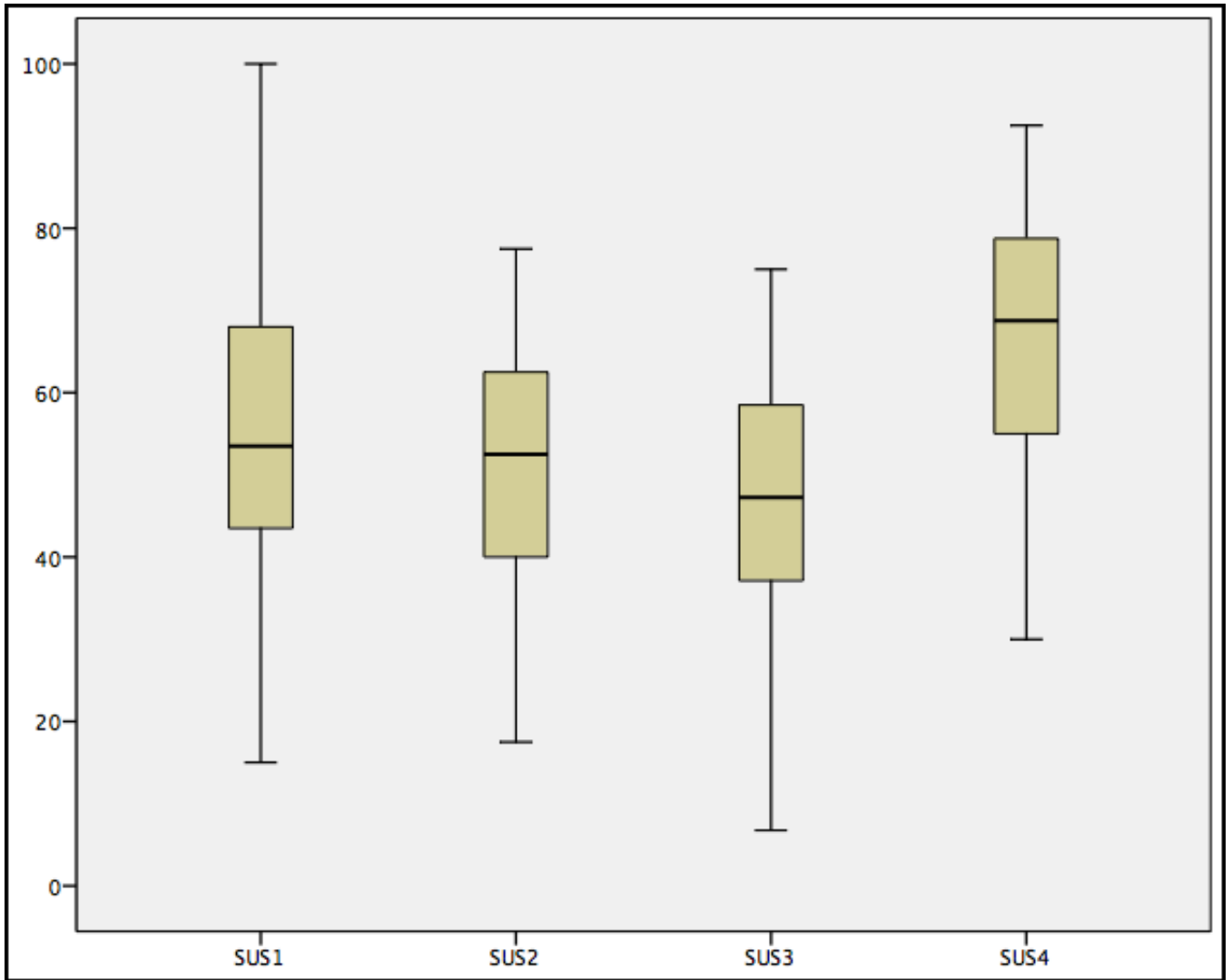


Figure 3. System Usability Scale: mean Scores

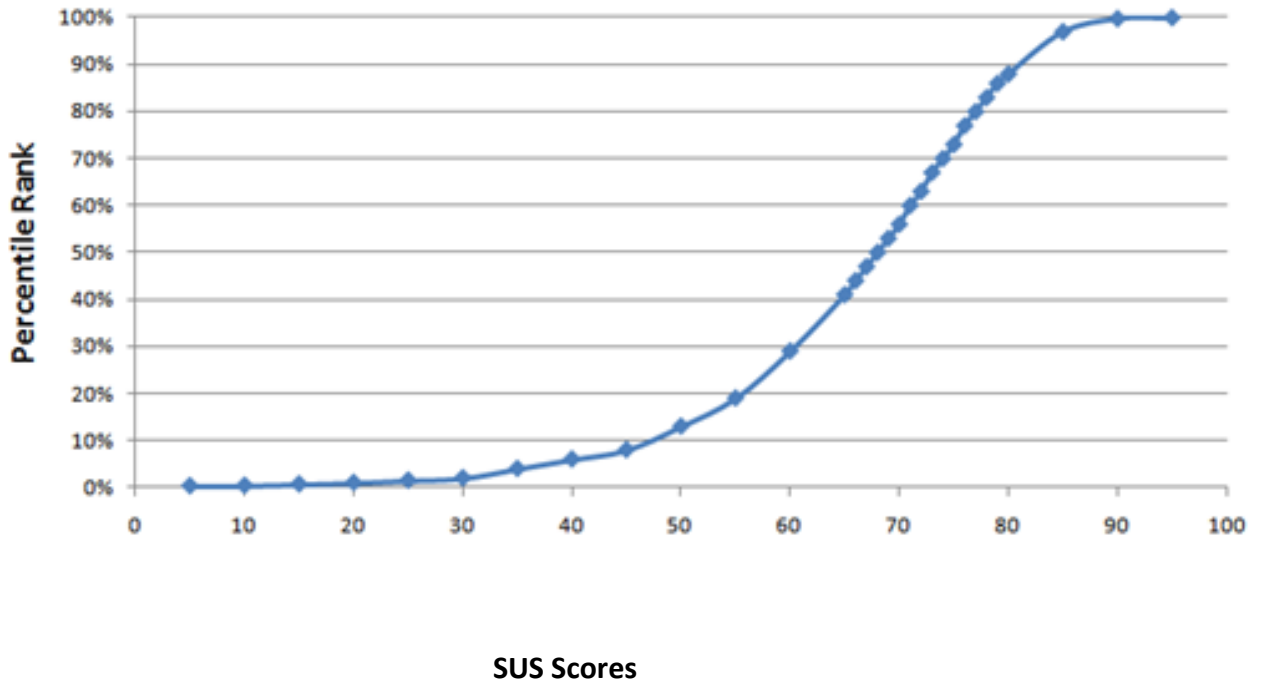


Figure 4. Percentile Ranks for SUS scores (see Sauro, 2011)

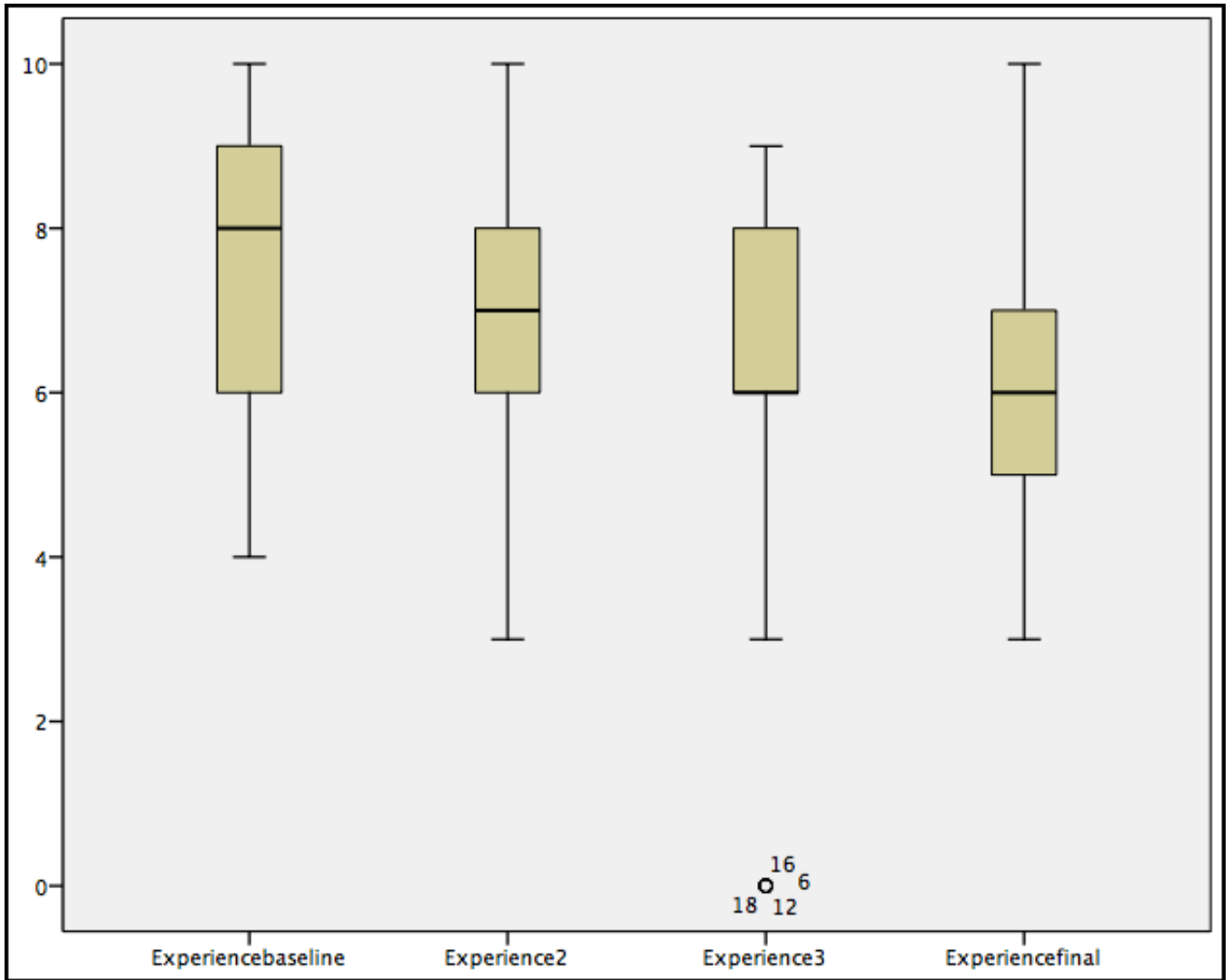


Figure 5. Boxplot showing different median Staff Engagement scores at all four time-points

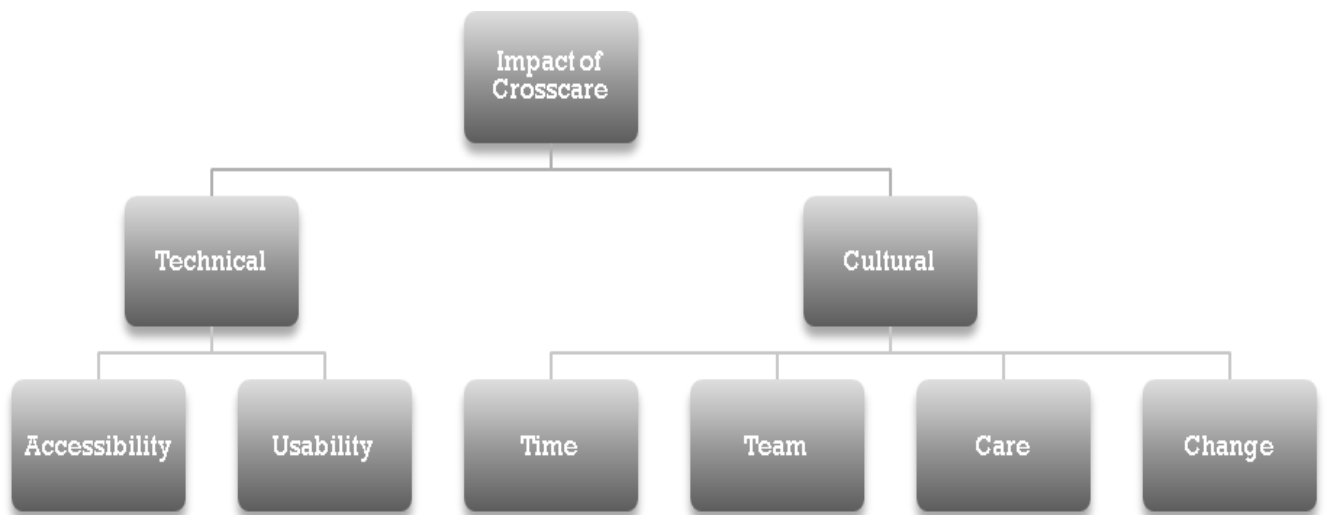


Figure 6. Thematic analysis of textual data

Crosscare Focus group- schedule

Can you describe the general feeling at the moment in the hospice towards Crosscare?

What change have you noticed to your working day?

Differences amongst staff groups?

Has [the implementation] had any impact on your relationship with the patient or how you carry out your job?

Thinking back to your training in Crosscare do you feel it prepared you to use the system? What do you think could make you feel less anxious?

What hopes in terms of improvements to your working day do you have for the system?

Despite any difficulties is it possible to see the positives?

Is there a gap between your hopes and the reality?

Time appears to be a big issue in terms of taking the time to learn a new system and then spending less time with the patient. Do you see this as a short-term issue or a problem that will continue?

What other impact does it have e.g. morale, efficiency, case load?

How do you feel supported during this process?

We would expect a 'teething period' with any new system. Why do you think some are more resistant than others?

How will this change?

6 months/1 year/ 2years from now what are your hopes in terms of patient care/staff morale/usability of the system?

Table 1. Focus group schedule

	Baseline	Second	Third	Final
Admin/Support staff	2	2	1	5
Care Assistant	12	6	3	16
Chaplain	1	1	1	0
Doctor	2	2	3	4
Manager	3	2	4	1
Nurse	28	26	17	23
Occupational Therapist	1	1	2	2
Pharmacist	1	2	1	0
Physiotherapist	1	0	3	1
Social Worker	1	2	1	0
Other	2	3	0	3
Total	55	48	36	55

Table 2. Respondents at each point

Technical Issues		Cultural Issues			
<i>Accessibility</i>	<i>Usability</i>	<i>Time</i>	<i>Team</i>	<i>Care</i>	<i>Change</i>
<p>“It takes considerably longer time to access specific information on Crosscare than was my experience with paper notes, accessing and finding a specific letter /correspondence is very time consuming.” (Inpatient staff; 3)</p>	<p>“[finding information] was an issue in the past, so much time wasted if you can’t read the notes. You would give up...in the past I would go around looking for case notes and that was quite time consuming as they weren’t always available. So from my perspective having [Crosscare] saves me a lot of time.” (Non-nursing staff; F)</p>	<p>“[I have] significantly increased the time spent sitting at a desk typing in data, in comparison to time taken completing paper records.” (Clinical staff; 3)</p>	<p>“We rely very much on team support because you go onto the system off/ on /off/ on /off all the time because it’s very time consuming so we have to give each other time to do the notes.” (Nursing staff; F)</p>	<p>“I do not think it has improved patient care, and in-fact feel the opposite. From my perspective the introduction of the computerised clinical system, Crosscare and computerised care plans and documentation has had a negative impact on patient care.” (Clinical staff; 3)</p>	<p>“Change in culture is happening and this is positive. Everyone is committed to doing a good job. However the amount of extra work that is added onto staff without an evaluation of its impact on their main job can create problems with health and culture.” (Nursing staff;</p>

"It's very slow. If we're out and about and you need to switch it on for whatever reason, it takes a long time to wind up."
(Community staff; F)

"My main complaint with Crosscare is with regards to its very poor "readability"...font size is very small, only small area on the screen where text is displayed, individual episodes of care are very repetitive/wordy and thus difficult to read." (Nurse; 3)

"You can't afford three hours out of a normal working day to sit at a computer."
(Clinical staff; F)

"I feel it has had a negative impact on verbal communication within the team." (Nursing staff; 3)

"The key thing that patients and people want when they are approaching end of life care is the human touch – eye contact or hand touch and if you put some technology between us and them then you're in danger of losing ..."(AHP; F)

"The recent changes within the organisation...are deflecting from the direct heart of the Hospice. It feels like we are losing the crucial elements of care and compassion in favour of new technology..."
(Nursing staff; 2)

"It seems to take a long time to boot up sometimes, which can cause a delay in patient care/ contacting specific people eg NOK."
(Inpatient staff; 2)

"I don't think the system is user friendly and not really fit for purpose, I really don't. ..., it's screens and screens of information."
(AHP; F)

I worry all the time that I will not get Crosscare finished before my shift ends and

"... since its introduction, I have seen less patients in the community/ done less visits in the day and therefore argue whether that is

"Periods of change are never easy!!"
(Admin; 4)

I frequently
do not get
breaks
because of
this. (Nurse;
4)

person centred.”
(Community
staff; 2)

Table 3. Themed examples from the narrative data.