The use of visual images to convey complex messages in health settings: stakeholder perspectives.

Abstract

Visual tools are increasingly used in healthcare settings to improve the quality of care provided. While there are a number of tools and frameworks that focus on how to create effective visual tools, there has been little evaluation of their perceived efficacy. This paper presents findings from a project that sought to evaluate the use of visual images to convey quality improvement messages to healthcare professionals. The research setting was a UK Clinical Commissioning Group, however, the findings are readily translatable to other healthcare environments. The study employed a practice approach based predicated on a social constructionist standpoint. Semi-structured interviews with 26 healthcare professionals and participant observation were used to garner user perspectives. Here we present and discuss a thematic analysis of the interview talk, focusing on four emergent themes: design; facilitated insight; data density; and co-creation. From this, we draw two positive conclusions, first that the visual communication of complex messages to healthcare professionals can provide an efficient and effective mode of communication, and second that co-creation and inclusivity are key to success.

Introduction

Visual communication tools are increasingly popular in healthcare settings and are supported by organisations such as the institute for Healthcare Improvement [1]. Methods and techniques can include the graphical presentation of data [2], the visual summary of knowledge sharing events [3], visual epidemiology [4,5], the use of interactive boards[6], and patient communication boards [7,8]. Owing to this increasing use it is important to evaluate and reflect on their use in order to provide an evidence base for practice. The empirical exploration of visual communication in organisational settings has explicitly been called for [9]. While visual

approaches have been found to yield benefits in terms of efficiencies and quality improvement and allow innovative approaches to patient centred care. Visual tools are often used in continuous improvement projects and applications of healthcare management tools such as Lean and Sigma Six [10,11].

Little has been published addressing stakeholder use and perception of such methods [9]. With this in mind, this paper focuses on the perceptions of key stakeholders involved in the development and use of images used by an NHS Clinical Commissioning Group (CCG) to convey complex messages to their staff and service users. Four themes emergent from the findings of semi-structured interviews are discussed in relation to this; these are: design, data density, facilitated insight, and co-creation. We conclude by making three globally transferrable recommendations for practice.

One explanation for the rise in the use of visual communication tools in healthcare settings is their association with widely used approaches to management and service delivery. As stated, visual communication is key to management frameworks such as lean and quality improvement that have gained much kudos within healthcare settings [12]. Such approaches respond to increasing complexity in healthcare delivery and advocate visual tools to support efficient communication. The accessible nature of visual communication can also support patient centred approaches to service provision and the co-production of service experience [13]. Personalised healthcare approaches now characterise healthcare service delivery and policy agendas worldwide [14]. Indeed, the visualisation of healthcare information to be shared among staff and patients has been found to result in a wide range of benefits such as improved diagnostic accuracy [2], improved discharge processes [5], patient inclusion [173], and efficient patient flow [16].

In addition to the rise in visual management and communication methods, a range of strategies and frameworks to improve their use are beginning to emerge [17,,12,18,19]. These approaches will be discussed in further detail shortly. Important here is the fact that these approaches focus on the content of the image itself, limited research has been done to explore viewer and user perception of the use of visual images to convey information. We argue that such research is necessary to both add the depth of information called for [9], and also to ensure the improved and effective use for communication in health settings. Before the findings of the study are discussed an overview of the visual management literature is provided.

Visual management

Following the increasing use of visuals to convey information in management and organisational settings, a number of frameworks for their use have been proposed. The Collaborative Dimensions Framework (CDF) [17] focuses on the content of the image and outlines seven key issues to support collaborative work: visual impact; clarity; perceived finishedness; directed focus; inference support; modifiability; and discourse management. Images can be evaluated on these issues to gauge effectiveness.

Similarly, McCandless [18] advocates for the interrelationship between four foundational issues in order to ensure successful visual communication; including a combined focus on the information to be conveyed, the story to be told, the purpose of the image, and the visual form chosen. Fundamental to this is the interrelationship and co-presence of each of these four elements, each element brings its own characteristics that when combined serve to produce an engaging and effective image. Other approaches to producing effective visual management tools have focused more specifically on particular types of tools. Including; visual management

principles to guide the design of visual communication boards [12] and the visual display of quantitative information particularly focusing on the use of colour, ink to data ratio and data density [19].

Each of these strategies focus on the production of visual management tools to ensure effective images. As outlined in the introduction there has been less focus on whether or not users feel such images are effective. Resulting in the specific call for further investigation of the use of visual tools in organisational settings [9]. This call outlines five different research designs for doing so, based on the starting point that visual images are positioned not simply additions to verbal text, but that they are more than this and serve as a reflection of social reality. Owing to this, visuals vary in format, can be used for a number of purposes and viewed by a range of users. The five proposed research designs reflect this diversity and include: the archaeological approach, the practice approach, the strategic approach, the dialogical approach and the documenting approach [9]. Our study operationalises the practice approach.

The practice approach begins from a social constructionist standpoint whereby visuals are viewed in terms of artefacts that are both socially constructed and socially constructing. In other words, the reality presented in the image can only be known through social interaction and social interaction would not occur if the object was not present. In this way the practice approach positions visuals in terms of 'socially meaningful material objects that are created, employed, and manipulated in organisational contexts, making them a constitutive part of social practices' [9:492]. This starting point underpinned the methodological approach taken in the study discussed here, in that the study was interested in exploring the efficacy of the use of visual images to convey complex information to healthcare professionals. Viewing the images under review in terms of both socially constructed and socially constructing artefacts, allows

this aim to be meaningfully explored in a way that will be useful for practice. The research design is now detailed.

The study

The project was based on the use of visual commination by a CCG in the English Midlands. In the UK CCGs commission the majority of the community and hospital health care services available within set geographical boundaries. Services typically include emergency care, community health services, and rehabilitative care. The communication of complex service messages is part of everyday CCG work.

The CCG had been using what they referred to a 'graphicing' to engage staff and service users in the co-production the services they commission. This involved the simplification of complex messages into visual images to be shared with healthcare professionals. The general perception across the CCG and other stakeholders was that the graphicing method was a useful tool that allowed staff and service users to gain an informed and holistic understanding of services. In order to provide a robust evidence base for the use of the graphicing method, the empirical study set out to evaluate the efficacy of this method of communication by asking the following research questions:

1. How are the images produced and used?
2. How are the images perceived by stakeholders?

These questions aimed specifically to explore user perceptions of the visual communication of complex messages. To do this the project focused on the use of images produced through graphicing in two commissioning areas: the system of care provided for frail older patients and the redesign of patient pathways in the cardiology and respiratory service area (See figures 1, and 2).

(******* INSERT FIGURE ONE HERE PLEASE **********)

(******* INSERT FIGURE TWO HERE PLEASE **********)

The image shown in figure one was produced to provide stakeholders in the frailty service area with a comprehensive overview of all of the services available for frail older people. This was a finished image that had been produced iteratively in conjunction with key stakeholders. The images shown in figure two had been produced to convey service change information to affected stakeholders and were 'working documents' in that they were designed for consultation purposes. We purposely selected images at differing stages of 'completion' in order to gain an appreciation of the whole image creation and use process. While we have used the terms 'finished' and 'working documents' to describe the stage of image production, it is important to note that the graphicing process is an ongoing iterative method, where even 'finished' images can be reviewed and revised.

All of the images convey complex information and visualise care pathways that include multiple stages and options that can be different for different patients. In both cases the images had been co-produced using a range of engagement activities. The overall aim of the visualisations was to bring this complexity together to present an overview of the pathways in a way that could facilitate shared understanding and ownership across a range of stakeholders.

In order to effectively explore this aim a qualitative design based on the practice approach to investigating the use of images in the specified service areas was chosen in order to gain an in-depth understanding of use. The practice approach is typically carried out in situ, focuses on

currently used images, and includes the use of methods such as observation, interviews and focus groups [9]. In line with this the researchers attended a range of engagement workshops to observe the co-produced nature of the images and their use in practice, and carried out semi-structured interviews with key stakeholders, including: healthcare professionals such as consultants, nurses, and pharmacists; managerial staff; and admin staff. An interview schedule was used flexibly to facilitate discussion (see table 1)

(**********INSERT TABLE 1 HERE PLEASE**********)

The interviews were conducted largely during engagement workshops that had been arranged as part of the design and consultation process for the production and dissemination of the visual artefacts. This allowed a large range of stakeholders to be incorporated in the research who would otherwise not be easily accessible to the researchers (See table 1).

(**********INSERT TABLE TWO HERE PLEASE**********)

The participants were informed about the research and interviewed as individuals or groups according to how they chose to interact with the researchers. The project was granted ethical approval from the University of Leicester and written consent was obtained from all involved.

The interview transcripts were analysed using thematic analysis [20] This involved: familiarisation with the data, coding; the identification of themes within, between and across codes; review of the themes; formalisation of the themes; and write up. The participants' talk was initially organised into 29 codes using Nvivo 12 Pro. Four principle themes emerged from the 29 codes, these are: design; facilitated insight; data density; and co-creation, see figure 3. Some codes did not fit into these themes and were quite generic and descriptive such as

"venue", "job role2, "useful" and "overview". These were not included in the development of themes and are shown as 'other' in figure 3.

(**********INSERT FIRGURE THREE HERE PLEASE**********)

Findings and discussion

Overall, the themes discussed are situated within a general mood of acceptance and appreciation.

Theme 1: Design

This theme refers to the visual elements of the images rather than the design process. The focus here is the stakeholder perception of the visualisations as standalone images. The participants referred to the visual impact of the images, focusing on the use of colour, the use of cartoon images, and the novelty of receiving service information in a visual format as opposed to textual or statistical format and said things like:

P2: I mean I like the colour, they are interesting to have a look at the minute you walk in a room.

P23: It's colourful and it makes you want to have a look at it. It's quite engaging.

The participants also liked the use of images of people referring to it as 'childlike but not childish' (P17). The images of people were said to 'humanise' the complex messages conveyed. Participants said things like:

P3: just putting pictures of people on it just makes it feel a little bit more real, doesn't it?

Interviewer: What aspects of the visuals have people liked?

P19: The use of characters. I think the great thing about it is that it sort of humanises the process in a way.

Many of the participants felt that the visual format reflected their learning styles better than more traditional forms of communication such as reports and graphical data, describing themselves as 'visual learners' (P19), as being 'very visual' (P6), as 'a bit of a scribbler' (P3), as 'a check list person' (P1), and as 'constantly forming pictures in my mind' (P26). In addition to their own learning style the participants welcomed the inclusive nature of the images and related this to the inclusion of diverse groups as when P26 said:

P26: The great thing about graphicing is the images are fairly simplified, the outlines are simplified, regardless of your cultural background or your educational attainment or any of those things, iconic images like that, so generic men, women, etc., including hijabbed women or people of colour, if you've generic images like that it just means it can be done much more quickly and it's still comprehensible. I think it still transcends cultural boundaries etc., and it's just more time efficient.

The crux of the participants talk about the visual impact of the images is that they saw this mode of communication as being more accessible than more traditional modes of communication that can be jargon based and exclusive to those without a clinical background. The images were thought to bring together a range of information that could be easily

comprehended. This theme, moreover, links with the 'visual impact' element of the Collaborative Dimensions Framework (CDF) referred to earlier [17]. Visual impact refers to the influence the image has on the viewer and includes elements of the image such as story content, expressiveness, and the use of colour and icons. As shown the visual impact of the images in this project was positive. According to the CDF [17], the visual impact is not a necessity for the success of an image, indeed, they warn against the potential negative outcomes that an image with a strong visual impact can have on the creation of collaborative knowledge creation. According to the collaborative framework [17], a strong visual impact could result in passive viewing, whereby the viewer does not feel in a position to improve the image or think outside of the story being told. This was not the case for the images evaluated here, whereby the strength of the visual impact resulted in the participants' engagement with the images and reporting a range of additional thoughts regarding the content or story of the images.

The findings presented here are more in line with McCandless' [18] approach to the production of effective images, in that the visual form is considered to be one of the four fundamental elements for success. McCandless [18], lists beauty, harmony and appearance as factors within the visual form. While none of the images here were described as beautiful, the participants valued the harmonisation of the information being conveyed and the simplicity and openness of the visualisations. Justesen and Mouritsen [21] propose that visualisations are 'super real', in that they can cover multidisciplinary and multimodal information such as design, reporting, and accounting, and they can engage a diverse range of viewers. The images and the participants talk about them also reveal them to be super real in this way. The next theme data density is also closely linked to this and concerns the negotiation between detail and simplicity.

Theme 2: Data density

This theme highlights the participants' ongoing negotiation between detail and simplicity. The participants frequently talked about the challenge this presented. While the participants recognised the benefits of using visualisations to convey this complex detail as opposed to more traditional methods, when talking about how they will use the images and their involvement in the design, the balance between detail and simplicity was a common tension.

P19: The entire point of it is to simplify it so people can understand the process and just see it in their heads. If we add more information then it will become more like a written report.

P6: If you try and send out lots of wordy things people just won't read it, if it's just a picture, a lot of people don't read emails. No time.

P16: I find it much easier using the pictures than what traditionally, in the past, we've had a lot of writing of flow diagrams.

Here the participants welcome the shift from more traditional mode of communication. The simplicity of the image was widely viewed as a positive aspect of this form of communication, particularly for time saving purposes. Many of the participants discussed the challenge of producing simplicity but still communicating complex detail. The participants considered issues such as what information to include/omit, level of detail, key messages, and ensuring that the image maintained its status as an image, as seen below.

P26: There's also that danger around that you end up, in reaching for comprehensiveness, not leaving anything out and making sure that people see their services are mentioned in here, so if you're talking to somebody what they want to see is, "Well, where does

my service fit in here?" or "Why haven't you mentioned my service?" So you can overcompensate and make it a too cluttered image and at the same time you want to give enough information there that you're not answering 50 questions about why 'x, w and z' isn't in there. So it's a bit of a delicate balance

P2: I think the way the arrows go from left to right and it's quite simple. [referring to images in figure 2] I think sometimes when you get something in the middle of a big piece of paper and all the arrows go off, and it just looks like a bit of spaghetti, it's a bit hard to understand sometimes and it takes a lot of energy to try and get your head round it.

Here the participants are discussing the need to balance complexity and simplicity. All of the images detail complex systems of care undergoing improvement changes. The aim of the 'graphiced' image is to accessibly convey complexity but without losing detail. In the visual management literature there is no one agreed upon level of data density [17,19]. In addition to this, it is generally considered that viewers can only hold a finite number (around seven) of chunks of information [22]. While the visual management literature is divergent on how much 'data' to include in a visual communication, the findings presented here show that the participants were more concerned about the story being told by the image, the comphensiveness of this and the desire to simply represent reality.

The combination of visual impact (discussed in theme 1) and the consideration of data density seen here resulted in images that provoked additional insight and idea generation.

Theme 3: Facilitated insight

This theme addresses the potential of the visual image to allow the viewer an additional insight or understanding of the message they are viewing. In other words, the capacity of the images to facilitate collaborative and individual learning and shared knowledge development. As discussed in theme one, the visual impact of the image was talked about in terms of accessibility which caused the participants to consider wider use of the images with non-clinical and diverse audiences. In addition to this the participants talked about how the images facilitated a wider understanding of the service area shown which in turn resulted in the development of shared knowledge.

P24: This [figure 1] was really helpful for us just to be able to say, "We've got this enormous elephant to eat, how on earth do you start to improve services when actually you've got all this complexity".

P26: Chess players talk about seeing the whole board and I think this helps you, from a strategic point of view, to say, "This is a system within a system." ….so that actually if we want to optimise patient experience of discharge, we need to think of the way we go about that in terms of systems and not in terms of a pathway.

Participants also talked about the potential for the images to begin conversations pertaining to improvement and change.

P20: [figure 2] helps me to pick out things that just don't make sense. It opens up a conversation with the clinical staff, we've realised there is possibility for a range of efficient improvements.

As seen in these extracts, it is the visual presentation of the complex stories being told that the participants' attribute to their facilitated insight. Visualising the 'enormous elephant' allowed things to be 'pick[ed] out that just don't make sense', 'to see where we have got the biggest gaps' and to 'build a picture of potential future changes'. The CDF [17] focuses the importance of openness in the use of visual images to facilitate shared knowledge, referring to the level at which a viewer can really interact with an image, such as by making modifications and drawing additional insight. In this way if an image is perceived to be 'finished' the viewer may not feel able to interact with the image at a deeper level and change/improvement opportunities could be missed.

Our study did not evidence this concern. Figure 1 was a 'finished document' in that it had been produced over a number of iterations with stakeholders and the image used for the project showed the system of care as it is enacted in practice, there were no plans to change the content of the image. Rather, its purpose was to facilitate ideas for improvement. The images in figure 2, however, were 'unfinished' and were designed to be modified through stakeholder consultation. Regardless of the finishedness of the image the participants talk showed the images facilitated a range of additional shared knowledge. The additional insight reported further added to the positive reception of the use of images to convey complex messages in that the kudos of the format was elevated as a consequence of this impact, reinforcing their status as 'super real' artefacts.

The communal nature of the images seen in the participants perception of accessibility and the potential for idea generation seen in the themes discussed is brought together in the next theme, co-creation. Indeed the capacity for facilitated insight demonstrated is dependent on the ethos of co-creation that is part and parcel of the graphicing method.

Theme 4: Facilitates co-creation

This theme refers to the co-created nature of the images. By this we mean that the image itself was produced using the knowledge and input of a variety of stakeholders to ensure that the image produced visualised a comprehensive representation of the complex message being conveyed. The participants' found that the co-created process of producing the images was particularly beneficial in terms of user buy-in and ownership of the messages being conveyed, as seen in the extract below:

P20: One of the biggest blockers is always about the staff really buying into the change, this has been really, really valuable because it's helped me to have that open discussion with the staff so that they can see what we're proposing and because we've held these consultation sessions I am actually asking them to then input and overlay their ideas and thoughts and questions on to what they can see. It's been a really useful vehicle for me to have that open dialogue.

An increased sense of ownership and buy-in to change is consistent with approaches to healthcare management that prioritise user inclusion [23]. The participants' talk about the images showed that this method of producing the image in turn created the potential for the co-creation of knowledge and understanding of the message conveyed. Explicitly, the inclusive nature of the graphicing method was said to result in holistic images that reflect reality and consequently provoke wider thinking. The participants said things like:

P16: It's been a team effort and getting lots of different people's opinions, it has given quite a lot of insight into how differently the teams work and that's been really helpful.

P26: One of the things I found interesting about the whole visualisation process is actually it's an iterative process, so very often, as I talk with other partners with some of their work, the process of visualisation and the process of constructing an image bring to bear, sort of artistic or creative thoughts. And, actually what you find is, your own thinking is enriched and developed because you're getting around that 'camp fire'.

In these extracts the participants demonstrate the potential created by the inclusivity of the graphicing method for collaborative knowledge sharing. It is this collaborative knowledge sharing that resulted in images that both reflected reality and also facilitated the co-creation of new ideas, as seen in the facilitated insight theme. Similarly, as seen in the extracts below, the participants also used examples of using the images with other stakeholders to share knowledge which then resulted in the co-creation of shared learning.

P21: I think for a workshop, it's very useful to have something like that in front of a group of people, because otherwise you all have your own understanding of what happens and unless you see it written down or drawn out, you can't really compare it.

P24: People liked it, I had a number of people come up from other systems, so the other CCG's in particular, came up and said, 'oh I really like the diagram and actually it was really helpful in us being able to understand what you were doing and it helped us to make some sense'.

Here the participants' talk shows that the co-created images and their consequent holistic, simple, and realistic representation facilitated the co-creation of shared understanding and knowledge. In this way the participants saw the images as useful learning tools that allowed

them to both locate their own role within the systems of care depicted and also to understand and links between other services within the system.

Conclusion and recommendations for practice

While the use of visual images to convey complex messages is increasing in healthcare settings and there are a variety of frameworks and principles to guide their successful use, there has been little focus on user perception [94]. The findings presented here focus solely on this and will hopefully spark further consideration of this important issue. For visual images to be truly successful, regardless of their content and the framework followed the user must feel engaged with the image [18].

Overall the graphicing method and the consequent images evaluated here were perceived positively by the participants. At a surface level the participants liked the 'look' of the images, commenting on the use of icons and colour. In addition to this the images were seen to be a welcome change from traditional modes of commination like reports and flow diagrams. Many of the participants reported having visual learning styles and so found the images to better reflect learning preference. The participants welcomed the inclusive approach to image production and linked this to both the visual impact, in that the images were thought to comprehensively represent reality, and also the consequent co-creation of shared knowledge both of the message being conveyed and also of additional learning and idea development. The participants' perception of the images were reflective of the assertion of immediacy [176] and the notion of 'super real' [217].

The themes presented and discussed show that this 'super real' aspect of the images is a consequence of a combination of factors both implicit and explicit in the graphicing process.

Specifically the combination of visual impact (aesthetics and accessibility), the co-created nature of the graphicing process and the consequent capacity of the images to facilitate additional insight, garnered the images credibility among the participants. These important elements are ultimately underpinned, and therefore, rendered possible through the ethos of co-creation and inclusion that is explicit within the images discussed. In including a range of stakeholders in the design iteration stage of image production, a holistic image is produced and those involved do not feel like passive recipients of a service message, but rather feel a sense of ownership and active involvement.

In contrast to the existing literature the findings presented here did not show any relationship between user engagement and the visual impact of the images as warned against [17]. Rather the opposite effect was reported, in that the visual impact of the images attracted the viewer to the images, resulting in the findings presented such as idea generation and facilitated insight. For those involved in the production of the image this seems to be a consequence of the inclusive approach to image production in that those who developed the image will also use the image in their service areas. For those outside of the production process using the image, such as the health and wellbeing board and the other CCGs referred to in the interview extracts, the visual impact appears to hold a novelty value in that those seeing it welcomed the change from long PowerPoint presentations or formal reports.

Overall the use of visual images to convey complex messages in this setting can be said to be a success. The immediacy and the super real nature of visualisations, in that the information contained spans a range of disciplines and actors and serves to organise their work in one totality, combined with the co-created approach to production can be seen as key to this success.

Recommendations for practice

In relation to the research findings we make the following four recommendations for the use of visual images in health care settings. While the study presented here focused on images produced using the graphing method particular to the CCG our findings and recommendations are transferable to other uses of visual images to convey complex messages and are not limited to the graphicing method or the UK.We make the following four recommendations:

1. Visual images should be considered for the communication of complex messages in health settings, particularly among multidisciplinary stakeholders
2. Any development of images to convey complex messages should be premised on a commitment to the co-creation of design, content and dissemination.
3. Development of images to convey complex messages should be treated as an iterative process. Consequently the idea of a final document might not be appropriate
4. The use of visual images in health settings will likely be useful for the dissemination of patient information based on the immediacy of the visual mode and its accessibility.

References

1. Institute for Healthcare Improvement. QI Essentials Toolkit. 2017. file:///C:/Users/sbrm939/Downloads/QIEssentialsToolkit.pdf Accessed November 2019
2. Garcia-Retamero R, and Hoffrage U. Visual representation of statistical information improves diagnostic inferences in doctors and their patients. *Social Science & Medicine*. 2013; 83: 27-33.
3. Poksinska B, Swartling D, and Drotz E. The daily work of Lean leaders–lessons from manufacturing and healthcare. *Total Quality Management & Business Excellence*. 2013; 24 (7-8): 886-898.
4. Cannuscio CC, Weiss EE, Fruchtman H, Schroeder J, Weiner J, and Asch DA. Visual epidemiology: Photographs as tools for probing street-level etiologies. *Social Science & Medicine*, 2009; 69(4): 553-564.
5. Raghupathi V. An empirical investigation of chronic diseases: A visualization approach to Medicare in the United States. International Journal of Healthcare Management. 2019 Oct 2;12(4):327-39.
6. Verbano C, Crema M, and Nicosia F. Visual management system to improve care planning and controlling: the case of intensive care unit. *Production Planning & Control*, 2017; 28(15), pp.1212-1222.
7. Singh, S., Fletcher, K.E., Pandl, G.J., Schapira, M.M., Nattinger, A.B., Biblo, L.A. and Whittle, J., 2011. It's the writing on the wall: whiteboards improve inpatient satisfaction with provider communication. *American Journal of Medical Quality*. 2011; 26(2): 127-131.
8. Wong HJ, Caesar M, Bandali S, Agnew J, Abrams H. Electronic inpatient whiteboards: Improving multidisciplinary communication and coordination of care. International Journal of Medical Informatics. 2009 Apr 1;78(4):239-47.

9. Meyer RE, Höllerer MA, Jancsary D, and Van Leeuwen, T. 2013. The visual dimension in organizing, organization, and organization research: Core ideas, current developments, and promising avenues. *Academy of Management Annals*. 2013; *7*(1): 489-555.
10. De la Lama J, Fernandez J, Punzano JA, Nicolas M, Nin S, Mengual R, Ramirez JA, Raya AL, Ramos G. Using Six Sigma tools to improve internal processes in a hospital center through three pilot projects. International Journal of Healthcare Management. 2013 Aug 1;6(3):158-67.
11. Peng, L.S., Rasid, M.F. and Salim, W.I., 2019. Using modified triage system to improve emergency department efficacy: A successful Lean implementation. *International Journal of Healthcare Management*, pp.1-5.
12. Author reference
13. Mclaughlin J. and Wysocki L. The role of comic format information sheets in explaining medical proceedures to children: Drawing the MRI scan. **British Sociological Association's Medical Sociology Conference** (Glasgow Caledonian University, 12-14 September 2018). medsoc presentation 11th sept 2018
14. NHS. Long term plan. 2019. Available at https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf Accessed November 2019
15. O'Brien L, Bassham J, and Lewis M. Whiteboards and discharge traffic lights: visual management in acute care. *Australian health review*. 2015; 39(2):160-164.
16. Chaboyer W, Wallen K, Wallis M, and McMurray AM. Whiteboards: one tool to improve patient flow. *Med J Aust*, 2009; 190(11): S137-S140
17. Bresciani S, Blackwell AF, and Eppler M. A Collaborative Dimensions Framework: Understanding the mediating role of conceptual visualizations in collaborative knowledge work. In Hawaii International Conference on System Sciences, Proceedings of the 41st Annual. 2008: 364-366
18. McCandless D. *Knowledge is beautiful*. William Collins: 2014

19. Tufte ER. *The visual display of quantitative information* (Vol. 2). Cheshire, CT: Graphics press: 2001
20. Braun V, & Clarke V. Using thematic analysis in psychology, *Qualitative Research in Psychology*. 2006; 3(2): 77-101
21. Justesen L, and Mouritsen J. The triple visual: Translations between photographs, 3-D visualizations and calculations. *Accounting, Auditing & Accountability Journal*, 2009; 22(6): 973-990.
22. Miller GA. The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological review*. 1956; 63(2): 81.
23. Voorberg WH, Bekkers VJ, Tummers LG. A systematic review of co-creation and co-production: Embarking on the social innovation journey. Public Management Review. 2015 Oct 21;17(9):1333-57.
24. Lee D. A model for designing healthcare service based on the patient experience. International Journal of Healthcare Management. 2019 Jul 3;12(3):180-8.