The Absence of Data Visualisation in Midwifery

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***Abstract*— Information visualisation creates visual representations that more easily convey meaningful patterns and trends hidden within large and otherwise abstract datasets. Despite potential benefits for understanding and communicating health data, information visualisation in medicine is underdeveloped. This is especially true in midwifery, where no qualitative research exists regarding the impact of different graphs on clinicians' and patients' understanding. This *position paper* is part of ongoing work investigating this gap and its potential impact. This work reviews a collection of literature from within the midwifery domain. We found almost two-thirds do not use data visualisation approaches to present knowledge realised from data, and those that did were generally restricted to basic bar charts and line graphs. Without effective information visualisation midwives will continue to be constrained by the challenge of trying to see what datasets.**

Keywords*— *data visualisation, information visualisation, midwifery

I. Introduction

Midwives generally work with well women and their babies, promoting and guarding normal birth and enabling informed consent and health education for women and their families [1]. While provision of direct patient care will continue to be the driving concern of midwifery, how midwives engage with patient data and research will evolve in the era of big data [2, 3]. Many consider data science the next evolution for midwifery, yet the literature shows that few actually understand what this means and the impact it may have [2-4]. Ubiquity of electronic health records (EHR) has changed the way we collect patient data, and as the domain of learning health systems (LHS) continues to evolve and receive greater attention from clinicians, it is possible for midwives to see that large collections of EHR can be the source of powerful and precise knowledge about medical diagnoses, treatments, and likely outcomes for individual patients [5, 6]. Midwives must first be able to understand current data and findings for themselves before being able to present information to pregnant women and their families in an accessible way that ensures understanding for the layperson. In this paper we show that data visualisation is especially underdeveloped in midwifery and we investigate the potential consequences of this problem.

II. The case for data visualisation

Increasingly, it is recognised that effective information visualisation may hold the key to unlocking access to understanding the complex data in EHR and LHS. Information visualisation is the study of transforming data, information and knowledge into visual representations that can more easily convey meaningful patterns and trends hidden within large and otherwise abstract datasets [7-9]. A 2011 report by the US Institute of Medicine (IoM) described information visualisation in clinical medicine as underdeveloped when compared and contrasted with other scientific disciplines [10].

Finding an appropriate and comprehensible form to visualise and communicate data with the public is a challenging task [11]. Several studies have investigated the effect of graphs in patients' and clinicians' understanding of medical risks [12-14]. The results are mixed and definitive recommendations cannot be easily made. Finding the most appropriate way to visualise data and communicate their messages depends on the presenters' objective, the communication context and the targeted audience [13, 15]. Users' likes and dislikes should be taken into consideration, but must not be treated as the gold standard [11]. For instance, users seem to prefer graphs that are simpler, but simple graphs are not always able to convey complex information which can lead to a misunderstanding [16]. [17] found that doctors performed worst with the format they liked best, and best with the one they strongly disliked.

Absence of or ineffective data visualisation has negative effects on clinical care, time efficiency and patient safety [18]. Those viewing raw or ineffectively presented data get lost, especially where they have to take data from one variable and relate it to data from another variable in order to arrive at meaningful information for use in immediate clinical decision-making [18, 19]. Effective data visualisation can mitigate the issues that arise when deep insight is required to analyse data and make time-sensitive decisions [19]. Providing visualisations for data supports users and mitigates the complex issues of comprehension, interpretability and navigation as they traverse large collections of information [20, 21]. Many studies into the benefits of data visualisation have been reported in non-clinical domains. Surveys within those domains confirm that professionals do recognise the

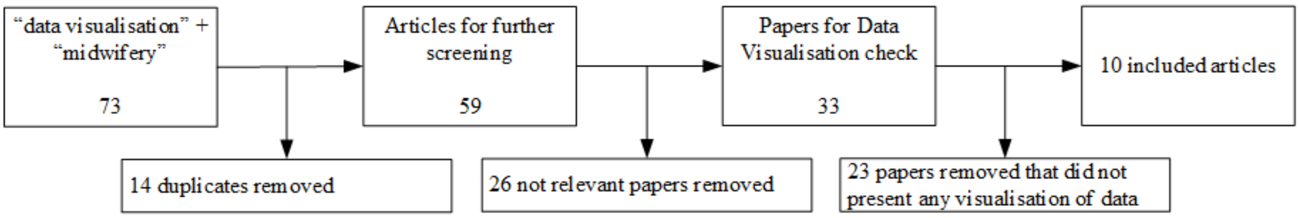

Fig. 1. Literature Search (PRISMA)

effectiveness of data visualisation techniques, however it is possible that professional scepticism regarding potential benefits acts as a significant limiting factor to implementation [22]. While it is difficult to know whether the specific benefits they identify are generalisable to a clinical context, the predominant benefits claimed include that the use of data visualisation:

- allows the viewer to understand patterns and relationships not clearly visible within the data [11, 19, 22];
- enhances communication of risks to a generic audience, especially a low-numeracy one [23];
- helps professionals to focus on, assimilate and recall issue-relevant aspects of the data [19];
- improves problem solving performance and decision-making abilities, including diagnostic and treatment reasoning [19, 23, 24].

III. Method

A search of academic databases was conducted using the terms "data visualisation" and "midwifery". Duplicates and papers not relevant to the topic such as those where the term midwifery was found as part of the school affiliation (School of Nursing and Midwifery) but where the topic was not related to midwifery practice were removed. Papers which spoke of data visualisation but failed to present a data visualisation in any form were also removed. As shown in Figure 1, this resulted in a collection of just 10 papers for use in this review.

IV. Results

Table 1 shows that the most common data visualisation method identified in this midwifery literature collection was the bar chart. Most authors presented a basic bar chart with at least three primary data sources: two being represented on X and Y axes, with the third providing granularity in data presented along one of those axes. Line graphs were the next most common method observed. A number of complicated or visually confusing methods were also identified, including: (i) Lex diagrams which were not easy to understand, representing the relationship between sentence order and content in midwifery literature [25], and plot diagrams using non-intuitive values on the axes where other values shown in the data tables may have been more engaging and informative to midwifery practice [26]. One paper [27] presented a method that used artistic representations of the pregnant feminine form to represent detail identified from within publicly available datasets released by the United Kingdom's National Health Service (NHS). Leaving aside the ethos and general philosophies of the authors, this paper presents their work on a cost reduction pamphlet that used graphical representations to present serious information in a manner equally approachable to health facility management, midwives and patients. [27] also present a model they term Graphic Fiction, which represents the pregnant woman's initial interaction with midwives upon entering a maternity unit in the shape of a pregnant woman, and on which those elements giving rise to data points in the EHR have been identified. Such approaches to information visualisation provide an engaging view of what can otherwise be seen as dull data.

These findings indicate that even more-so than was observed for medicine generally, data visualisation in midwifery is underexplored and underutilised. Few approachable examples of data visualisation in midwifery literature were identified in this brief study, and no literature has studied or classified methods or makes recommendations for midwives on how to present data for professional and lay audiences. This means that not only are midwives not being exposed to data visualisation approaches that could improve their understanding and assimilation of clinical data, but that many may also lack awareness of potential approaches and the benefits that may result from their use. Based on our experience reviewing literature in the midwifery domain, the authors feel these findings are unlikely to be limited only to the literature collected during this study. Rather, and as the

TABLE I. VISUALISATIONS IN MIDWIFERY

Source	Line Graph	Bar Chart	Cluster Plot	Mind Map	Lex Plot	Plot Diagram	Data Tables	Graphical Representations
Vivian-Taylor (2011)	✓							
Doherty et al (2019)	✓	✓						
Gao (2016)	✓	✓						
Ngana et al (2012)		✓						
Hauck et al (2015)		✓						
Noonan (2013)				✓				
McKinnon et al (2015)					✓			
Jonsson et al (2018)								✓
Pino et al (2016)						✓		
Mathews et al (2019)							✓	

IoM contends for medicine, that they may be valid across the entire body of the literature. This can only be established with further investigation.

A limitation of this study is that it only sourced papers in the midwifery domain that specifically used the term data visualisation. Future work should include; (i) review of a broader collection of midwifery papers, for example, the entire collection of midwifery papers published in a given month or year, to ascertain the distribution and scope of data visualisation for the domain, (ii) an assessment of the impact of different visualisation formats on midwives' clinicians' and patients' data understanding.

V. Conclusion

Data visualisation is necessary to complete understanding and contextualisation research and evidence. This *position paper* has presented formative work investigating the use of data visualisation within the domain of midwifery. The consequences of poor data visualisation can impact midwives' understanding of data and current research, and limits their ability to present information to colleagues and patients in an approachable form. Research is needed to assist midwives who work with or publish research using data to identify and present data in a focused issue- and audience-relevant manner. Without this, midwives will continue to be constrained by the challenge of trying to see what datasets hide.

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Competing Interests

No author identified a competing interest relevant to this research.

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