The use of graphic displays and their influence on awareness and understanding of patient safety incidents: An exploratory study

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Abstract

Background: Medical incidents cause harm in both human and veterinary care. Repercussions are similar and reach far beyond the patient, negatively impacting the people close to the patient, healthcare professionals, and the healthcare organization. Whilst good practice is to capture events in incident reporting systems to facilitate learning, critics argue that there is too much focus on this process and too little focus on harnessing the benefits from the data. This exploratory study aimed to investigate how graphic display of data could influence awareness and understanding of patient safety risks.

Methods: A dashboard graphically displaying incident data was created and a mixed methods approach was utilized to investigate how the dashboard influenced participants awareness and understanding of incidents. Quantitative pre-intervention and post-intervention survey data was integrated with semi-structured interview data through a pillar integration process.

Results: The survey response rates were 48% ($n = 77$) and 46% ($n = 74$), and 12 interviews were conducted. The four pillars: Emerging enlightenment, tools, behaviours and habits, language and education were identified. There was a difference in understanding of incident data between clinically and non-clinically trained participants.

Conclusion: This novel study suggests that graphic displays of data may bring increased understanding of safety risks, trigger activity, and bridge conversations between clinically and non-clinically trained stakeholders.

Keywords

Incident reporting, organizational learning, business intelligence systems, patient safety, graphic visualization

Introduction

Incident reporting in human healthcare

In human healthcare, it has been a growing trend to capture patient safety incidents in incident reporting systems (IRS) since the landmark report 'To Err is Human' was published in 2000.[1] The incident reporting process consists of several steps: recognition that an event has occurred, capturing and analyzing data, addressing underlying issues, and sharing learnings and feedback. A patient safety incident is defined as an event or circumstance that could have resulted, or did result, in unnecessary harm to a patient.[2]

What value IRS bring has been debated, with studies presenting both advantages and disadvantages.[3,4] Sceptics argue that healthcare has incorrectly focused on capturing data, a dataset that does not provide a trustworthy index,[4–8] and missed introducing the necessary systematic investigations needed to see improvements.[9] Advocates, on the other hand, argue that capturing data brings valuable insights into safety hazards[10–13] and weaknesses in systems.[14] These insights can facilitate an essential understanding of what causes or contributes to the incidents, allowing for preventative measures and learnings, both within[15] and across individual hospitals.[16]

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Incident reporting in veterinary care

IRS are a relatively new phenomenon in veterinary care.[17,18] Published data suggests that 40% of reported incidents involve harm to patients, medication related-incidents being most common, and anesthesia-related incidents most severe.[19] Feedback, learning opportunities, and a structured reporting system are facilitators to reporting, while fear, lack of time or understanding, and organizational concerns are barriers.[20] Challenges faced in veterinary care, such as communication barriers between teams,[21] limited resources to process and respond to incidents in a timely manner, alongside difficulties in capturing and analyzing incidents accurately and efficiently, are similar to what has been seen in human healthcare.[3]

Business intelligence tools

In a data-driven world, effective and timely access to information is essential for successful organizations.[22,23] However, deriving proper value from data is often challenging, resulting in difficulties integrating data-driven insights into routine business operation.[24] The public is exposed daily to enormous amounts to comprehend, with one estimate suggesting that the average person is exposed to data equivalent to 147 newspapers every day.[25] Therefore, a shift from capturing data to making sense of data has been seen in the past decade.[26] Easy access to such information is of importance, hence the growing use of business intelligence systems (BIS). BIS are digital tools capable of managing and analyzing large amounts of data in a systematic and precise way. The fundamental principle is to make it easier for leaders to see patterns, trends, and risks, as well as simplify the comparison of groups and quantities, all of which can support well-informed decisions.[27]

Using images to convey a message – How it works

The concepts of visual display are influenced by psychology, usability, graphic design and statistics.[28] Nearly half of the cerebral cortex is busy processing visual information[29] and the visual interpretation of data can enhance comprehension by forming mental images to convey information. Done well, visual images help illustrate relationships by highlighting meaning and reducing complexity. Graphical display of large amounts of complex data in ways that require little, or no effort allows intuitive interpretation, which is often easier to digest and remember compared to text. Thereby graphic display could facilitate overcoming barriers such as time and information overload. Infographics are one sort of data visualization among many others.[30] This communication technique is not new; an early example comes from the nineteenth century when Florence Nightingale graphically depicted how death from preventable disease outnumbered other causes of mortality amongst British forces fighting in the Crimean war (Figure 1).[31] 'When babies are born' is a more contemporary example illustrating the power of graphic display (Figure 2).[32] In human healthcare, graphic display of patient-reported outcomes show promising results and studies are identifying guidelines for presentation of data to promote clinician and patient understanding.[33]

Study aim

This study aims to utilize the principles of BIS to explore whether an interactive dashboard can help increase understanding and awareness of patient safety incidents. Furthermore, it examines if there is a difference in understanding between clinically and non-clinically trained participants, between countries, or between different levels in an organization.

Materials and methods

An exploratory mixed-method approach was employed to investigate how different stakeholders perceive their awareness and understanding of incident data. Two surveys were utilized to collect quantitative data, one to capture awareness and understanding before having access to a BIS, and one after. To further explore the views on what the analytical tool could or could not offer, in light of the survey results, semi-structured interviews were performed. Following initial data analysis an integrative interpretation of results utilizing a Pillar Integration Process (PIP)[34] was conducted.

Participants

This study was conducted in a small animal veterinary group in Mainland Europe in May 2022. Purposive sampling was used with participants from 101 clinics, in 8 countries, on 3 levels of the organization (Figure 3), with a mix of clinical and non-clinical backgrounds and responsibilities. The participant information sheet and consent form were distributed to participants together with information about the study. Participation was voluntary and not incentivized. Participants had access to incident data for clinics under their jurisdiction in a tabular format in the IRS prior to commencement of this study. The study only included participants in charge of the 101 clinics who had reported an incident in the company's voluntary IRS within the previous 12 months to ensure relevant data.

Incident reporting system

The IRS is cloud-based, accessible to all associates in the organization, with an incident form built on free-text

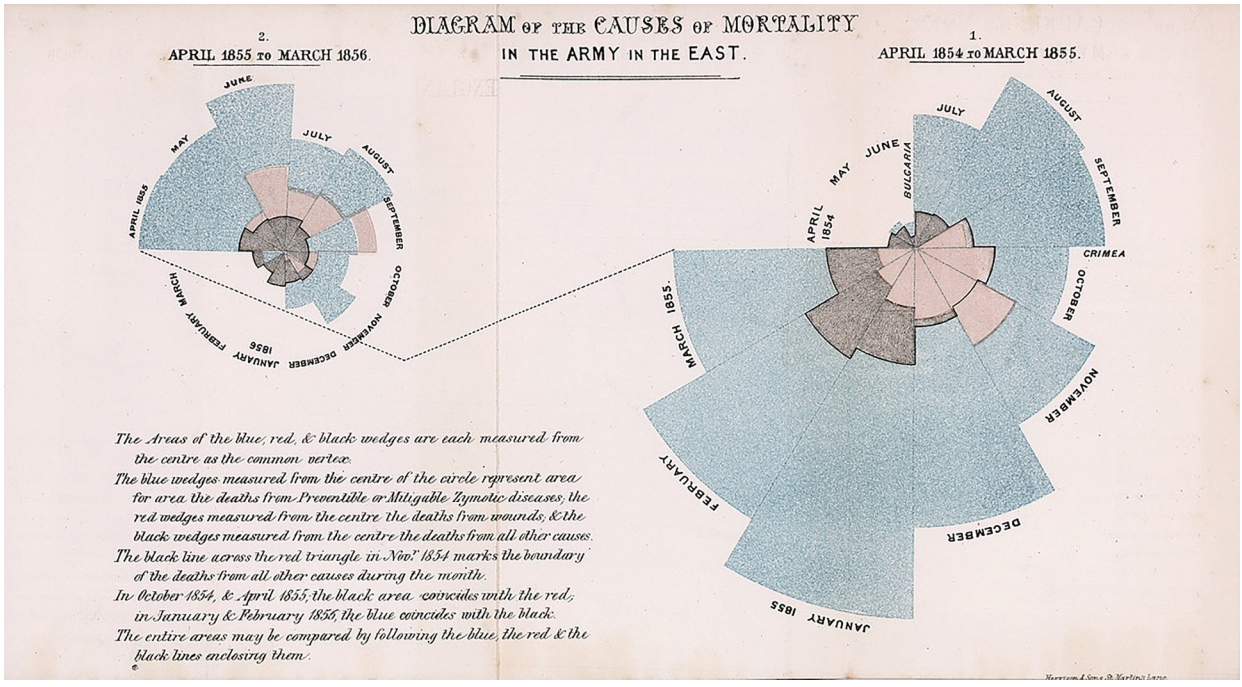

Figure 1. Florence Nightingale's two graphs represent deaths from sickness, wounds and other causes. Each segment, proportional to the number of deaths per 1000 soldiers, represents 1 month.

fields and drop-down menus. The system is described in detail in a previous publication.[19]

Dashboard

An interactive dashboard was created in the software visualization product Power BI (version 2.105.1143.0), developed by Microsoft. The dashboard aimed to increase and simplify access for managers owning resources contributing to patient safety. The dashboard included eight pages explained in Table 1. The dashboard graphics were a mix of pie charts, bar charts, area charts, decomposition trees, ribbon charts and tables (Figures 4, 5 and 6). The pages include filters and selection fields allowing the user to cut and slice the data. A Microsoft Excel sheet, extracted from the company's voluntary IRS, was used as raw data for the dashboard. All person-identifying data were excluded.

Questionnaire

The purpose of the questionnaires was to capture awareness and understanding of incident data. The questions were adapted from the Technology Acceptance Model, a validated approach for evaluating perceived usefulness and perceived ease of use of technology.[35,36] The questionnaire consisted of two sections: one for demographics and one for awareness and understanding (Table 2). Participants were asked to share additional information about patient safety, incidents, incident data, access to data, their role, and the dashboard (only in the second questionnaire) in free text fields. The second questionnaire had the same questions as the first one, but with an additional section of five questions about the functionality and relevance of the dashboard. The surveys were anonymous in order for participants to provide honest responses and to avoid biases. Pre-access and post-access to the new visualization, participants were invited to respond to both questionnaires. Likert responses were graded using a four-point or five-point ordinal scale (1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree, 0 = not applicable).

Data collection

The questionnaires were sent to participants via personalized email with written consent gathered before participation, with reminders to increase response rates. To gather qualitative information and gain a deeper understanding of the value of the tool, 12 post-survey semi-structured interviews were conducted with participants from each organizational level, with medical and/or operational responsibilities. In the interviews, participants were asked to describe what value it brought having access to the dashboard. Interviews were held digitally using Microsoft Teams, and field notes were taken continuously. Probing questions were asked to obtain further information when needed. The point of theoretical saturation served as a guidance for the number of interviews. By saturation, we mean that there was enough information to provide a logical analysis and theme production, not that more interviews would not produce new ideas. During the analysis process field

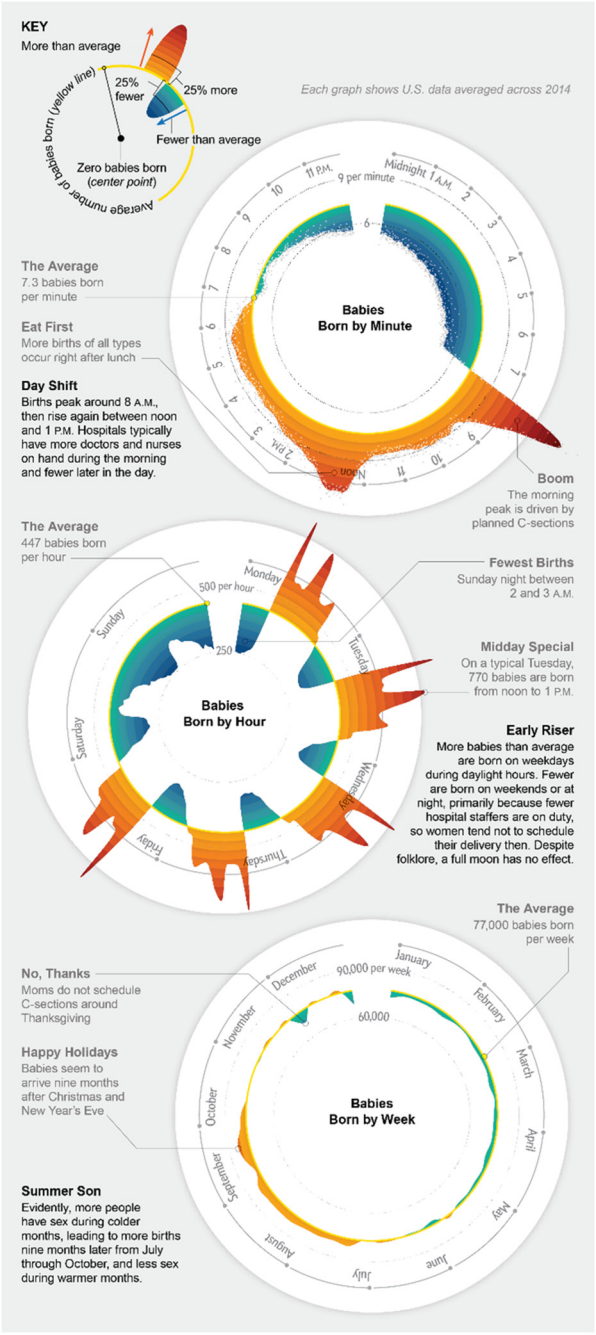

Figure 2. The graphic 'when babies are born' designed by Bremer and Armstrong. Reproduced with approval from designer.

notes and recorded material were merged. Interviews were held in Swedish or English, depending on the preference of the interviewee.

Quantitative analysis

Descriptive statistics and analysis were employed using Microsoft Excel and IBM SPSS Statistics for Windows, version 28. Questionnaire results were categorized for a group level comparison, generating an independent sample for statistical analysis. Responses regarding staff roles were grouped to levels 1 to 3. Responses were split between questionnaires one (Q1) and two (Q2) to compare the difference of pre-access and post-access to the dashboard. Responses were split between clinical versus non-clinical background to explore if there was a difference between the two groups. Non-parametric data were compared using the Mann-Whitney test or the Kruskal-Wallis test. The null hypothesis was accepted if the p-value was <0.05.

Qualitative analysis

Inductive thematic analysis[37–39] was applied to identify themes across the interview dataset. Both analyses were performed using NVivo 12. The process of developing themes was done by first reading the data and highlighting text excerpts relevant to the research questions. The excerpts were reduced by coding, following merging into clusters. The clusters were transformed into higher-level insights as themes. Throughout the process, the researcher went back to the raw data to anchor findings. Identified themes were continuously verified with the wider research team.

Integrative analysis

To improve the synthesis and integration of data PIP was used to combine quantitative and qualitative data.[34] In the listing process quantitative raw data and qualitative themes were presented in different columns, followed by matching and checking of findings. To conceptualize insights, the findings were compared and contrasted in the final pillar building step, formulating the integrated analysis of the different data sources. Since the quantitative data was the first data collection source it was listed in column A. The qualitative finding matching a quantitative finding was listed in column E. This process allowed organization of coherent organization of data and subsequent pattern identification.

Results

Comparing pre-access and post-access to dashboard

Out of 160 persons invited to participate, 77 (48%) participated in Q1 and 74 (46%) in Q2. The distribution of respondents was similar in both questionnaires, with level 2 having most participants, followed by levels 1 and 3 (Table 3).

Participants came from Belgium, Denmark, Germany, Italy, Norway, the Netherlands, Spain, and Sweden. In both questionnaires most respondents were Swedish (Q1: 39%, $n=30$, Q2: 34%, $n=25$), followed by Dutch (Q1:

Figure 3. The three different levels of area responsibility in a small animal organization.

Table 1. Description of how the data is presented in a dashboard for incident report data.

Dashboard page	Description
Selection	Page with filters for country, clinic, year, month, type of incident (on two levels), and degree of harm
Incident overview	• Key Performance Indicators (KPI) (unique clinics reporting, total number of incidents created, total number of completed incidents, total number of incidents under review, and total number of incidents waiting for analysis) • Chart graph for number of incidents per month • Bar chart with percentage of incidents being processed
Degree of harm	• KPIs for degrees of harm • Pie chart with the degree of harm including assessment of preventability • Bar chart per month with incidents per species
Location of incident	• Incidents per month in a ribbon chart • Bar chart with total number of incidents per location • Bar chart breakdown per the past 30 days
Incident map	Decomposition tree with category, location, degree of harm and species
Incident type	• KPIs for incident status • Column bar for incidents per species • Incident per type of practice (primary, referral or mix) • Pie chart for time for analysis (within 6 weeks from report)
Action overview	• KPIs for actions (created, ongoing and completed) • Bar chart of incidents and actions per month • Comparison status for actions
Incident details	Same KPIs as on incident overview page Table with all incident information in detail with free text fields (except who reported the incident)
Action details	Same KPIs as the action overview page Table with all action information
Clinic split	• Column chart of number of incidents and status • Dense table with the number of incidents per month and clinic • List of top/bottom reporting clinics

27%, $n = 21$, Q2: 28%, $n = 21$). In both questionnaires, a little more than two-thirds of the participants responded that they had good knowledge of interpreting data in dashboard format (Q1: 68%, $n = 49$, Q2: 63%, $n = 45$).

There was no statistical difference before and after access to the dashboard in awareness of numbers of incidents, types of incidents, severity of incidents, or the likeliness of resource allocation for working with incidents (Figure 7). There was no statistical difference in the self-assessed awareness and understanding of the incident data between the different countries or between the different levels of responsibility. Eighty-six percent found the dashboard user-friendly (agreed 64%, $n = 47$; strongly agreed 22%, $n = 16$), and 89% reported that they were either

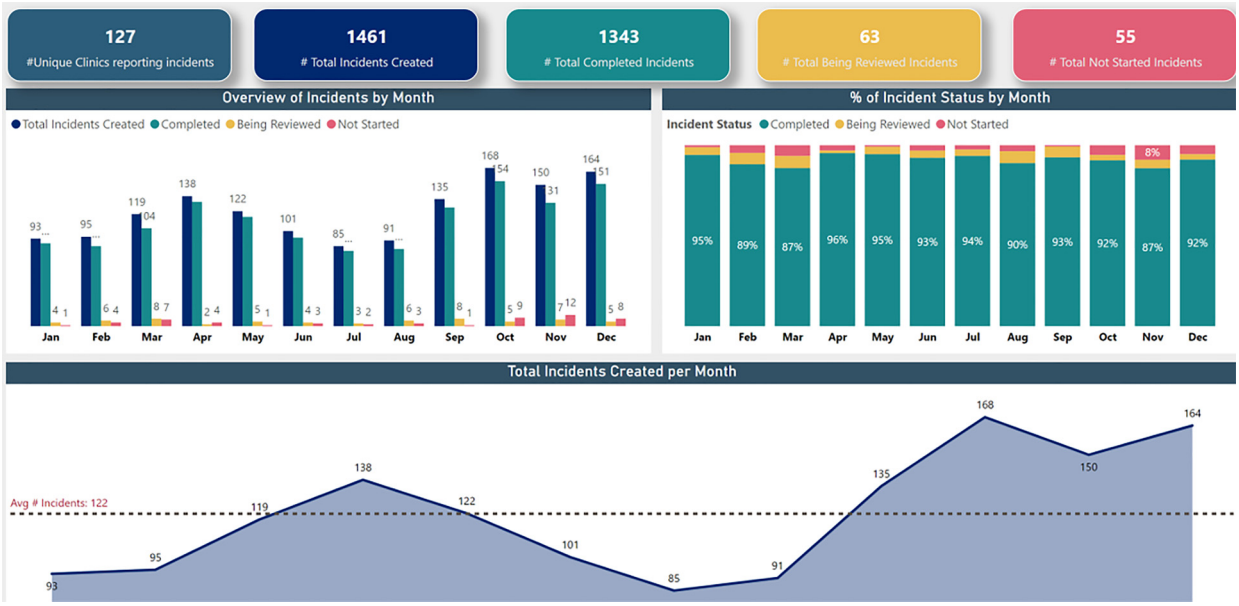

Figure 4. Dashboard displaying the number of incidents reported in a small animal practice incident reporting system.

likely (54%, $n = 40$) or highly likely (35%, $n = 26$) to revisit the dashboard. Time was stated as the primary barrier to revisiting (45%, $n = 33$), followed by awareness of existence (12%, $n = 6$), relevance to role (11%, $n = 8$), or relevance of content (11%, $n = 8$). Forty-two percent ($n = 31$) were positive about receiving push notifications about incidents.

Differences between clinical and non-clinically trained individuals

Seventy six percent ($n = 25$) of non-clinically trained participants self-assessed to have excellent knowledge about working with dashboards, while 58% ($n = 69$) of the clinically trained participants did. Awareness of the number, types and severity of incidents were comparable between clinically and non-clinically trained participants. More than 90% of the clinically trained participants agreed or strongly agreed lessons could be learned from incidents, whereas only 58% of the non-clinically trained participants did (Figure 8). This finding was statistically significant ($U(N_{\text{non-clinically trained}} = 33,\ N_{\text{clinically trained}} = 118) = 1207$, $Z = -3.65$, $p \leq 0.05$).

Clinically trained participants, compared to non-clinically trained, were significantly ($p \leq 0.05$) more likely to allocate resources – particularly protected time for team members to focus on patient safety (Figure 9).

Qualitative results

Interviewed participants came from Sweden, France, the Netherlands and Belgium, whereof four were male and eight were female. The interviews varied between 14 and 32 min. Four core themes were found and formulate what a dashboard may provide.

Theme 1 – reflection: Participants described the dashboard bringing deepened insights and understanding of the data and thereby incidents. '*It transforms from being single incident into a whole*' (interviewee no. 4). The aggregated data presented signals of direction and meaning. Technically participants were able to view incident data and clinic of origin in a table-like format with limited filtering functionality in the IRS prior to the dashboard launch. However, during interviews, participants shared that they only accessed the IRS to view individual cases and did not extract the data for further analysis of active clinics, trends and patterns. The dashboard graphicalization made it '*much simpler to get information*' (interviewee no. 6) and was an '*excellent basis for deep dives*' (interviewee no. 8).

Theme 2 – catalyser: This theme encompasses how the dashboard may act as a *catalyser* helping stakeholders to follow up. '*[Company IRS] is something that is in the background. It was by looking into Power BI that I realized that one clinic had stopped reporting. It became obvious to me*' (interviewee no. 6). Viewing the data in a dashboard triggered a practice manager to remind their team to get better at reporting since their '*few reports did not say much*' (interviewee no. 4).

Theme 3 – collaboration: There was a difference in how participants with medical or non-medical backgrounds could use the data. While interviewees with medical experience appreciated the details of the data, operationally

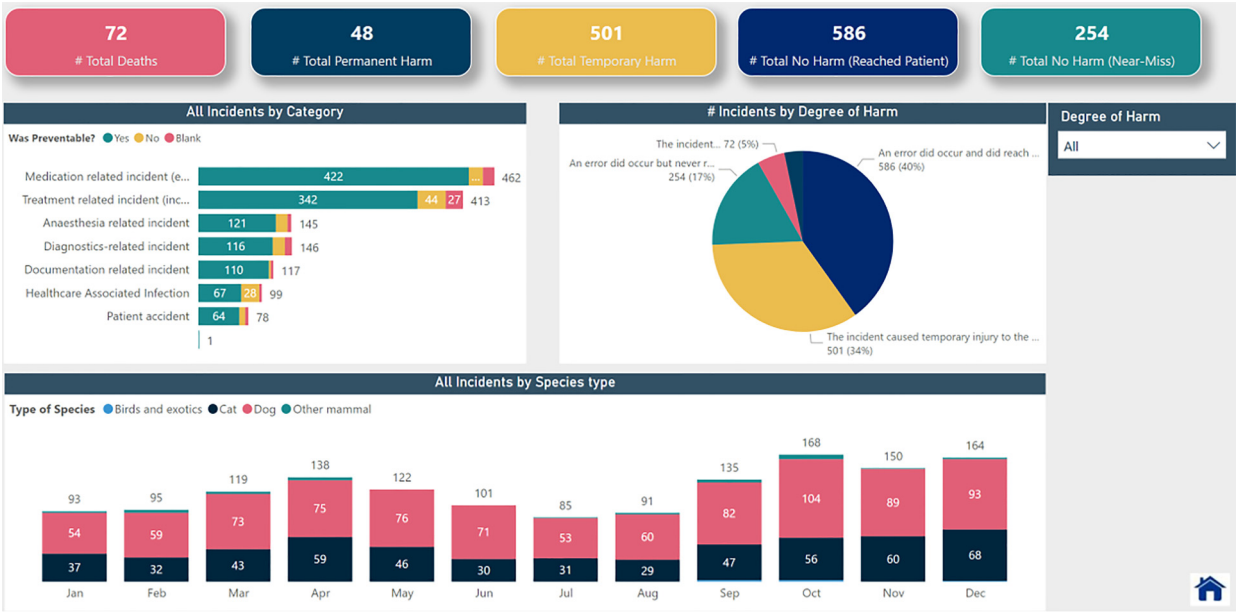

Figure 5. Dashboard displaying the types of incidents reported in a small animal practice incident reporting system.

Figure 6. Interactive ribbon page in a dashboard displaying incidents reported from in a small animal practice incident reporting system.

Table 2. Questionnaire exploring understanding and awareness of incident data in a small animal veterinary group in Mainland Europe.

Questionnaire	Question type	Answer options
Section 1. Demographics and knowledge		
What is your staff role? Select ONE answer that best describes your primary role	Multiple choice	Role type
I hold a vet/nurse qualification	Multiple choice	Yes/No
I am a trained	Multiple choice	Qualification degree
I work in	Multiple choice	Country
I review incident data from [Company IRS] for	Multiple choice	Responsibility area
I would describe my current knowledge of graphic display on a dashboard for interpretation of data as excellent	Multiple choice	4-point Likert scale
Please feel free to write any comments about patient safety, your role or incident data	Free text field	NA
Section 2. Awareness		
I am aware of the number of incidents that are reported in [Company IRS]	Multiple choice	4-point Likert scale
I am aware of what types of incidents we have reported in [Company IRS]	Multiple choice	4-point Likert scale
I am aware of the severity of harm our incidents, reported in [Company IRS], have	Multiple choice	4-point Likert scale
I am aware of the learnings and improvements that have been made as a result of incidents analysed in [Company IRS]	Multiple choice	4-point Likert scale
My current understanding of the [Company IRS] data influences my focus and allocation of my or my team's resources on patient safety	Multiple choice	5-point Likert scale*
Please feel free to write any comments about the dashboard, patient safety, incidents, access to data or your clinic	Free text field	NA
Section 3. Dashboard (only included in the second questionnaire)		
The [Company IRS] dashboard was easy to understand and navigate	Multiple choice	4-point Likert scale
I am likely to revisit the [Company IRS] dashboard	Multiple choice	4-point Likert scale
The primary barrier to using the dashboard is:	Multiple choice	Selection of options
Would you prefer to get information about incident data as push notifications via email?	Multiple choice	Yes/Maybe/No
If yes, how often would you like to receive a push notification?	Multiple choice	Selection of time options
Please feel free to write any comments about how you would like to get information about patient safety incidents	Free text field	NA

*Five-points because a 'not applicable' option was included for participants without resource ownership. IRS: incident reporting systems.

focused interviewees vocalized that '*the data does not say much*' (interviewee no 7) and that the '*responsibility to make something out of it must lie within the medical organization*'.

Theme 4 – fragile data: A proper understanding of the limitations of the data in the context of patient safety is critical to avoid incorrect inferences. One example was when a senior leader expressed that '*I am a big fan of looking into trends and it is good to see a decrease in the number of incidents*', suggesting this indicated that fewer incidents were happening, while in fact it could be due to staff not reporting because of, for example, high workload. The same participant raised the concern that there was lack of data to benchmark with.

Integration of quantitative and qualitative results

From the PIP process the four pillars *emerging enlightenment*, *tools, behaviours and habits* and *language* were identified (Table 4). Each of the pillars is reported below.

Pillar one – emerging enlightenment: The usefulness of the dashboard changed, with an increased value acknowledged over time. At first, when participants were introduced to the dashboard, its usefulness was not realized, reflected in the lack of difference in the two surveys. As users became more accustomed with the tool, their understanding of its potential as a monitoring and analysis tool was realized. The tool could aid in the continued advancement, unlocking new insights into how and when incidents occur.

Table 3. Distribution of participant from the different levels in the questionnaire pre-access and post-access to dashboard.

Area of responsibility	Q1		Q2	
	n	%	*n*	%
Level 1 – One clinic	34	44	29	39
Level 2 – A region/country/countries	38	49	41	55
Level 3 – All clinics	5	6	4	5
Total	77		74	

Pillar two – tools, behaviours and habits: A tool, such as a dashboard, can influence the development of new behaviours in various stakeholder groups. For instance, the more operationally oriented stakeholders expressed avoiding accessing the incident handling system to view the status of incidents and that they rarely conversed with the

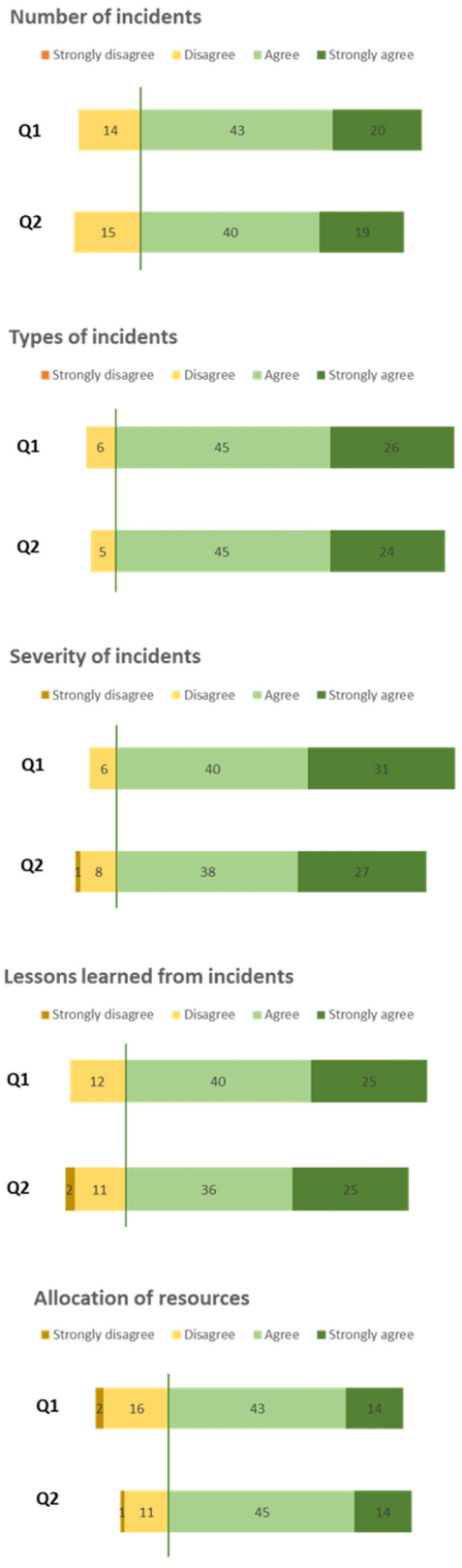

Figure 7. Comparing questionnaire responses between surveys 1 and 2. There were no statistical differences between the two surveys.

medical team leaders about incidents. Nevertheless, this changed once they had access to the dashboard, potentially aiding in developing new behaviours.

Pillar three – language: Clinically trained participants had a better understanding of incidents and their impact, compared to operationally oriented participants. The tool did however function as an understandable language for non-clinically trained participants, making it easier for stakeholders with various background to collaborate and engage with the data and subject of patient safety.

Pillar four – education: The importance of having educational material and trainings explaining the fragility of the data to all stakeholders was captured in interviews only. Clinically trained participants, such as veterinarians and nurses, were more likely to focus on patient safety, perhaps as it is a core component of their job and professional responsibility.

Discussion

Both human healthcare and veterinary care encounter similar challenges with regards to gaining insights from medical incidents and effectively managing data. This exploratory study, the first to explore what value displaying incident data visually brings to stakeholders in organizations, is showing promising findings in how to overcome those challenges. Findings suggest that graphic display, a novel method to display incident data, increased the awareness and understanding of 'what was going on' in the clinic and worked as a trigger for interaction and follow up between different levels of stakeholders. Quantitative findings suggest that clinically trained participants, compared to non-clinically trained, had better understanding of implemented learnings and were more likely to allocate resources to patient safety. The majority of participants responded that they were likely to revisit the dashboard; with time identified as the main barrier.

Aiming to increase access and insights of incident data, the dashboard helped visualize which clinics recorded incidents, and which did not. For participants responsible for a region of clinics, a country, or across the group it was now clearly visible, suggesting the tool had deepened their knowledge of the data. If a large size clinic had few reports, that was taken as a 'call to action' and put on the agenda, suggesting that viewing facts could trigger attentiveness. This may be explained by the findings from Pandey et al.,[40] who discovered that a participant's initial attitude affects how easily they can be persuaded by data. Data presented graphically rather than in a table is more likely to influence participants with little or an initial negative attitude about a subject, whereas participants with initial solid opinions were less likely to be

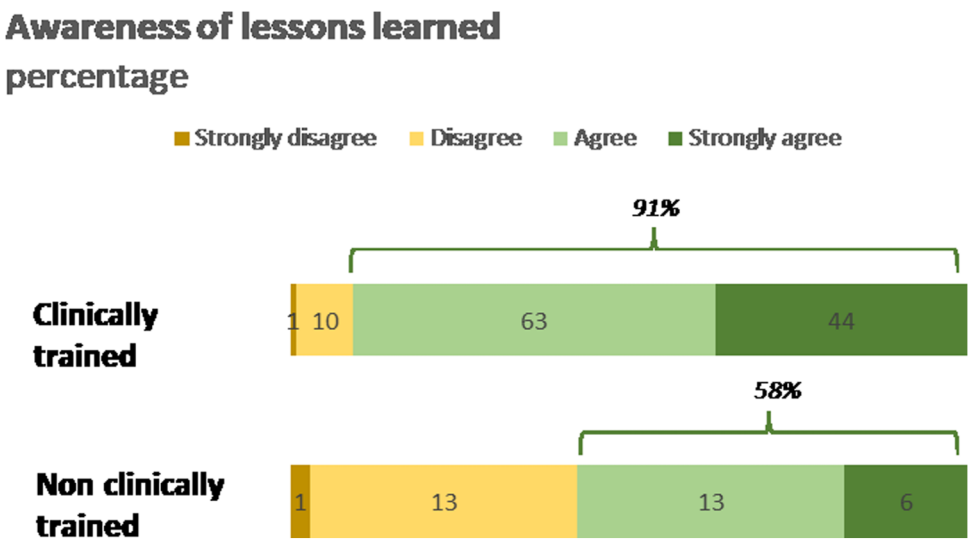

Figure 8. Comparing clinically versus non-clinically trained participants responding to awareness of lessons learned from incidents, with clinically trained participants significantly more aware.

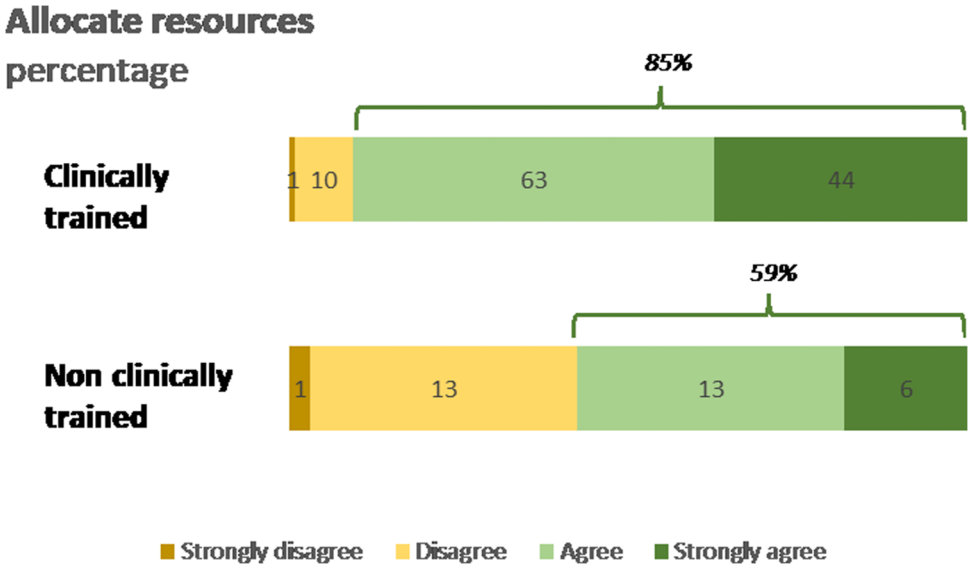

Figure 9. Comparing clinically versus non-clinically trained participants responding to the question 'My current understanding of the incident data influences my focus and allocation of my or my team's resources on patient safety'. Findings suggest that the increased understanding of the incident data significantly influenced clinically trained participants to allocate resources to patient safety.

convinced by evidence provided in a table.[40] The dashboard was found by participants to work as a trigger, which is promising, since action is needed to form habits.[41] With the dashboard working as a trigger, it could potentially be used to form habits relating to patient safety. It would be interesting to investigate if the trigger would be strengthened by a preceding event, for example by a notification from the dashboard.

Similarly to human healthcare, the scarcity of resources makes it important to have timely access to data in a smart way.[3] Without a way to view data as a whole, grouped or segmented, there is a risk of not capturing trends indicating safety hazards or outliers that signal for attention. With time the dashboard was found a useful tool for monitoring and analysis.

In human healthcare, Kam et al.[42] used a mixed-method approach to study how IRS could stimulate social and participatory learning. They found that 'IRS both hits and misses the mark',[42] suggesting that even though IRS contributes to a range of procedures, reflection and opportunities for aggregated learning do not get as much attention as it should. Initiating conversations about clinical matters

Table 4. A visual display of the integration and syntheses of quantitative and qualitative findings.

Quantitative			Qualitative	
Data →	Categories	Pillar	Categories	Data ←
Comparing questionnaires 1 and 2 No statistical difference in awareness and understanding of the number, types or severity of incidents. Nor in the knowledge of lessons learned. No difference in likeliness to allocate resources to patient safety. Comparing levels 1 to 3 No statistical significance in awareness and understanding of the number, types or severity of incidents. Nor in the knowledge of lessons learned or allocation of resources to patient safety.	Inability to reflect/ capture awareness and understanding	Emerging enlightenment	Deepened insight	*Reflection* *"Transforms from being single incidents into a whole" (interviewee no 4).* *"Excellent basis for deep dives"* (interviewee no 8).
89% reported that they were either likely (54%, $n = 40$) or highly likely (35%, $n = 26$) to revisit the dashboard. Time was stated as the primary barrier to revisiting (45%, $n = 33$), followed by awareness of existence (12%, $n = 6$), relevance to role (11%, $n = 8$), or relevance of content (11%, $n = 8$).	Utilisation of dashboard	Tools, behaviours and habits	Action trigger for interaction	*Catalyser* The dashboard enabled participants to quickly access and analyse key data, making it possible to act and make informed decisions. Users could identify and address issues or opportunities in a timely and effective manner.
Comparing clinical vs non-clinical qualification Clinically trained participants were more aware of lessons learned and more likely to allocate resources to patient safety initiatives.	Effect of stakeholder qualification	Language	Ownership	*Collaboration* The data can function as a link and that collaboration between stakeholders owning resources and stakeholders with the right medical competence is vital to improving patient safety in veterinary organizations.
NA	NA	Education	Educational material explaining what the data does and does not do	*Fragile data* Vital to know and understand the limitations of the data to avoid incorrect inferences. For example, fewer incidents reports do not necessarily mean fewer incidents in practice.

such as patient safety can be challenging for non-clinical leaders.[43] Findings in this study suggest that conversations between stakeholders with different areas of responsibility and professional groups were seldomly held but having an analytical tool was found to assist facilitating patient safety-related conversations.

The results suggest that participants with a medical education valued the dashboard more, since it provided them

with both high-level and detailed information about reported incidents may not be unexpected. However, it indicates that the tool's usefulness may vary depending on stakeholder and that it could function as a link for collaboration between different stakeholder groups.

While incident data can be used as one piece of the puzzle to identify learnings, trends and areas of risk, findings in this study suggest that it is important to keep the *fragility* of the data in mind to avoid incorrect inferences. Concluding that there is a decrease in incidents because the number of reports has gone down may be too simplistic if not considering that it could, for example, be due to staff not having time to report incidents, not knowing how to report, or not wanting to because of how a previous colleague was treated when they did report an incident.[8,9,44] Reporting maturity, culture, subjectiveness of reporting and technical IRS restrictions are some of the factors contributing to making the data fragile. A complementary method, using an observational session, for example, to confirm or explore findings further, is recommended. In human healthcare, a UK study concluded that medical record restrictions profoundly reduced the capability of research studies, and considering the implications of the restriction is vital since they underpin evidence based-medicine.[45] Creating educational material and conducting regular training to complement the digital tool may help ensure understanding of the data and how it can be acted upon.

Study limitation

The participants in this study were selected based on whether they were responsible for a clinic that reported incidents or not. Thus, these findings only represent the group of stakeholders with reporting clinics, excluding the experience from stakeholders with clinics not reporting incidents. It could be interesting to show non-reporting stakeholders' data from other clinics to understand if that could stimulate reporting. Whilst the survey questions were adapted from the validated TAM, they were not validated in this context which may have introduced limitations in the dataset. Future research studies could validate the questionnaire. The participant response rate was low in both questionnaires. A low response rate could compromise the reliability of the findings and question the conclusion. The follow-up interviews, however, might have assisted in contextualizing results. Not collecting person identifying responses in the questionnaires made it impossible to pair results pre-dashboard and post-dashboard access. This resulted in comparing the results of population groups, rather than at an individual level, potentially desensitizing the method from detecting difference.

Conclusion

This study is a first step in exploring how patient safety can benefit from the utilization of BIS in healthcare professions. Visual display of incident data indicates promising results which may help overcoming challenges associated with IRS. A dashboard tool might trigger activity, as well as function as a language to bridge conversations between clinically and non-clinically trained stakeholders. Educational material and training for healthcare managers and leaders explaining what the data is, and what it is not, as well as how to interpret and act upon it, is important. Clinically and non-clinically trained participants understood the data differently, highlighting and emphasizing the need of having a diverse range of expertise among leaders in veterinary organizations. Further research, both with data display methods similar and contrasting to the ones used in this study, will strengthen the evidence base and our confidence in these findings.

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References

1. Institute of Medicine. *To Err is Human – Building a Safer Health System*. Washington: National Academies Press, 2000.
2. WHO. Conceptual Framework for the International Classification for Patient Safety. Epub ahead of print 2009.
3. Pham JC, Girard T and Pronovost PJ. What to do with healthcare incident reporting systems. *J Public Health Res* 2013; 2: 154–159.
4. Vincent C, Stanhope N and Crowley-Murphy M. Reasons for not reporting adverse incidents: an empirical study. *J Eval Clin Pract* 1999; 5: 13–21.

5. De Fatima Tavares Alves M, De Carvalho DS and De Albuquerque GSC. Barriers to patient safety incident reporting by Brazilian health professionals: an integrative review. *Cienc e Saude Coletiva* 2019; 24: 2895–2908.
6. Milch CE, Salem DN, Pauker SG, et al. Voluntary electronic reporting of medical errors and adverse events: an analysis of 92,547 reports from 26 acute care hospitals. *J Gen Intern Med* 2006; 21: 165–170.
7. Sari ABA, Sheldon TA, Cracknell A, et al. Sensitivity of routine system for reporting patient safety incidents in an NHS hospital: retrospective patient case note review. *Br Med J* 2007; 334: 79–81.
8. Shojania KG. The frustrating case of incident-reporting systems. *Qual Saf Heal Care* 2008; 17: 400–402.
9. Macrae C. The problem with incident reporting. *BMJ Qual Saf* 2016; 25: 71–75.
10. Pham JC, Story JL, Hicks RW, et al. National study on the frequency, types, causes, and consequences of voluntarily reported emergency department medication errors. *J Emerg Med* 2011; 40: 485–492.
11. Leape LL. Errors in medicine. *Clin Chim Acta* 2009; 404: 2–5.
12. Reason J. Human error: models and management. *Br Med J* 2000; 172: 393–396.
13. Wu AW. *The value of close calls in improving patient safety : learning how to avoid and mitigate patient harm*. Oak Brook, Illinois: Joint Commission Resources Oakbrook Terrace, Illinois, 2011. Epub ahead of print 2011. DOI: LK - https://worldcat.org/title/704267506.
14. Donaldson L. An organisation with a memory. *Clin Med (Northfield Il)* 2000; 2: 452–457.
15. Wagner C, Merten H, Zwaan L, et al. Unit-based incident reporting and root cause analysis: variation at three hospital unit types. *BMJ Open* 2016; 6: 1–8.
16. Hudson P. Applying the lessons of high risk industries to health care. *Qual Saf Heal Care* 2003; 12: 7–12.
17. Oxtoby C, Ferguson E, White K, et al. We need to talk about error: causes and types of error in veterinary practice. *Vet Rec* 2015; 177: 438.
18. Wallis J, Fletcher D, Bentley A, et al. Medical errors cause harm in veterinary hospitals. *Front Vet Sci* 2019; 6: 1–7.
19. Schortz L, Mossop L, Bergström A, et al. Type and impact of clinical incidents identified by a voluntary reporting system covering 130 small animal practices in mainland Europe. *Vet Rec* 2022; 191: 1–10.
20. Oxtoby C and Mossop L. Blame and shame in the veterinary profession: barriers and facilitators to reporting significant events. *Vet Rec* 2019; 184. Epub ahead of print 20 April 2019.
21. Russell E, Mossop L, Forbes E, et al. Uncovering the 'messy details' of veterinary communication : an analysis of communication problems in cases of alleged professional negligence. *Vet Rec* 2021: 1–11.
22. Mohr N and Hürtgen H. *Achieving business impact with data*, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/. https://www.mckinsey.com/~/media/mckinsey/business functions/mckinsey analytics/our insights/achieving business impact with data/achieving-business-impact-with-data_final.ashx (2018).
23. Matias M. Five advantages of data visualization. *Oct 2nd*, https://www.netquest.com/blog/en/five-advantages-of-data-visualization#:~:text=Data visualization provides us with a quick%2C clear understanding of,and draw conclusions and insights. (2018).
24. Datnow A and Hubbard L. Teacher capacity for and beliefs about data-driven decision making: a literature review of international research. *J Educ Chang* 2015; 17: 7–28.
25. Hilbert M. How to measure the world's technological capacity to communicate, store, and compute information part I : results and scope 1. *Int J Commun* 2012; 6: 956–979.
26. Liu S, Cui W, Wu Y, et al. A survey on information visualization: recent advances and challenges. *Vis Comput* 2014; 30: 1373–1393.
27. Zacks JM and Franconeri SL. Designing graphs for decision-makers. *Policy Insights from Behav Brain Sci* 2020; 7: 52–63.
28. Otten J, Cheng K and Drewnowski A. Infographics and public policy: using data visualization to convey complex information. *Health Aff* 2015; 11: 1901–1907.
29. Milner D and Goodale M. *The visual brain in action*. Oxford, England: Oxford University Press, 1998.
30. McCrorie AD, Donnelly C and McGlade KJ. Infographics: healthcare communication for the digital age. *Ulster Med J* 2016; 85: 71–75.
31. Nightingale F. *Notes on matters affecting the health, efficiency, and hospital administration of the British Army: founded chiefly on the experience of the late war*. London: Harrison, https://archive.org/details/b20387118/page/n21/mode/2up (1858).
32. Bremer N and Armstrong Z. Why are so many babies born around 8:00 A.M.? *Scientific American*, https://blogs.scientificamerican.com/sa-visual/why-are-so-many-babies-born-around-8-00-a-m/ (2017, accessed 8 December 2022).
33. Snyder C, Smith K, Holzner B, et al. Making a picture worth a thousand numbers: recommendations for graphically displaying patient-reported outcomes data. *Qual Life Res* 2018; 28: 345–356.
34. Johnson RE, Grove AL and Clarke A. Pillar integration process: a joint display technique to integrate data in mixed methods research. *J Mix Methods Res* 2019; 13: 301–320.
35. Davis FD. Computer and Information Systems Graduate Schooi of Business Administration Univeirsity of Michigan.
36. Gagnon MP, Orruño E, Asua J, et al. Using a modified technology acceptance model to evaluate healthcare professionals' adoption of a new telemonitoring system. *Telemed J E Health* 2012; 18: 54–59.
37. Braun V and Clarke V. Using thematic analysis in psychology using thematic analysis in psychology. *Psychiatr Q* 2014; 0887: 37–41.
38. Vaismoradi M, Jones J, Turunen H, et al. Theme development in qualitative content analysis and thematic analysis. *J Nurs Educ Pract* 2016; 6. Epub ahead of print 2016.
39. Braun V and Clarke V. Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. *Couns Psychother Res* 2021; 21: 37–47.
40. Pandey AV, Manivannan A, Nov O, et al. The persuasive power of data visualization. *IEEE Trans Vis Comput Graph* 2014; 20: 2211–2220.
41. Neal DT, Wood W, Labrecque JS, et al. How do habits guide behavior? Perceived and actual triggers of habits in daily life. *J Exp Soc Psychol* 2012; 48: 492–498.

42. de Kam D, Kok J, Grit K, et al. How incident reporting systems can stimulate social and participative learning: a mixed-methods study. *Health Policy (New York)* 2020; 124: 834–841.
43. Pun JKH. An integrated review of the role of communication in veterinary clinical practice. *BMC Vet Res* 2020; 16: 1–14.
44. Lawton R and Parker D. Barriers to incident reporting in a healthcare system. *BMJ Qual Saf* 2002; 11: 15–18.
45. Strongman H, Williams R, Meeraus W, et al. Limitations for health research with restricted data collection from UK primary care. *Pharmacoepidemiol Drug Saf* 2019: 777–787.