Title: Medical professionals' (mis)remembering of a simulated interaction with a patient: A medical misinformation effect

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ABSTRACT

Background: Memory plays a vital role in the reporting of medical errors. Current reporting policies allow clinicians days, or even weeks, to report medical errors. Decades of memory research demonstrates that memories of events can become distorted within minutes of being exposed to misleading information (misinformation).

Objectives: Our objective was to assess the extent to which clinicians could accurately recall aspects of an interaction with a patient shortly after the clinicians had been exposed to misinformation.

Methods: 13 clinicians individually participated in a simulated interaction with a patient. Shortly after the interaction, we misled the clinicians about several aspects of that interaction. A few minutes later, we tested the clinicians' memory for those misled aspects, along with other aspects we did not mislead them about. We also asked the clinicians how confident they were in their memory for those aspects. We tested clinicians' memory for the same aspects of the interaction again 15 working days later.

Results: We found clinicians were less accurate when we misled them about certain aspects of their interaction with a patient. Despite being less accurate, clinicians were just as confident about the aspects for which they had received misinformation as they were about the aspects they had not. Furthermore, after 15 working days, clinicians had poor memory for the tested aspects of their interaction.

Conclusions: Our results suggest that reports of patient safety incidents could plausibly be compromised by misleading information. Delays between patient safety incidents and the reporting of those incidents could therefore compromise our ability to understand the true causes of medical errors.

Key words: Memory, medical errors, misinformation

INTRODUCTION

The problem of medical errors

An estimated 3-5.2% of all hospital deaths are consequences of medical errors.[1-3] Medical errors are routinely investigated to determine their cause, and improve patient safety. These investigations often rely on patients' and clinicians' recall of the events in question, including information recorded in medical notes and incident reports. To identify the true causes of medical errors, it is important that clinicians can accurately recall their interactions with patients many days after those errors occur. Clinicians have up to two working days in the United Kingdom, and fifteen working days in New Zealand (NZ), to report serious or fatal incidents.[4, 5] However, decades of research in human cognition suggest that recall might be compromised even just a few minutes after the interaction.[6-10]

Memory for events

People do not notice—and therefore cannot encode into memory—all elements of events.[11] This incomplete encoding occurs regardless of a person's skill or familiarity with the situation.[12] Moreover, as time passes, memories decay or become inaccessible.[13, 14] There is reason, then, to suspect that when clinicians' reports of interactions with patients are written after a delay, those reports will be incomplete.

Delays also create opportunities for memories to become distorted as people encounter additional information about that event. For example, clinicians regularly encounter “postevent” information (PEI) about their interactions with patients in the form of written records, discussions at shift handovers, and conversations with others.[15, 16] Importantly, this PEI is sometimes misleading because of errors in transcription, inattentiveness, or miscommunication.[17] Misleading PEI is problematic because people can mistakenly incorporate it into their memory for the event itself, even if the event happened only 15 minutes earlier.[6, 7, 18] As a result, people may falsely, yet confidently, remember

experiencing aspects of an event that were merely suggested after the event—an effect known as *the misinformation effect*. [8-10, 19-22] Therefore, delays in reporting patient safety incidents provide the opportunity for clinicians to encounter misleading PEI, and possibly incorporate that information into their memory for their interaction with a patient.

Overview

To what extent can clinicians accurately recall aspects of an interaction with a patient in the face of the misleading PEI? To address this question, clinicians participated in a simulated interaction with a patient (hereafter, the “interaction”). Shortly afterwards, we misled them about some specific aspects of the interaction—but not other aspects—and then assessed how accurately they remembered the interaction. Fifteen working days later, we again assessed the clinicians’ memory for the interaction. We hypothesised that clinicians would incorporate the misleading PEI into their memory for the interaction. Therefore, we predicted that clinicians would mistakenly, yet confidently, report misleading PEI shortly after the interaction. More specifically, we predicted clinicians’ reports would be less accurate for aspects of the interaction that were the target of misleading PEI, compared to aspects that were not. Furthermore, we predicted that clinicians would also mistakenly report the misleading PEI weeks later. Such a pattern of results would suggest information clinicians gain access to after their interactions with patients could reduce the accuracy of their memories for those interactions. In turn, by undermining the accuracy of clinicians’ memories, postevent information could compromise investigations into the causes of medical errors.

METHOD

Ethics statement. We conducted this research in accordance with professional ethical standards, including APA, and it was approved by the Victoria University of Wellington’s School of Psychology Human Ethics Committee (project number 22265).

Design. We manipulated Type of Postevent Information (nonspecific, misleading) within subjects.

Subjects. Fourteen clinicians participated in the experiment. Data from one clinician who did not complete all phases of the experiment were excluded. The remaining thirteen clinicians (6 Nurses, 3 Physicians, 5 allied health professionals) were each qualified to assess patients in pain in their capacity as an employee of a public hospital.

Procedure. We used a cover story to prevent clinicians from putting more effort into remembering the interaction than they would usually do in a real-life patient interaction. More specifically, we told clinicians the purpose of the study was to examine “how clinicians show empathy when interacting with patients in pain”. The experiment was completed in two sessions over approximately 15 working days.

Session 1. Session 1 comprised four phases which clinicians completed individually. In the first phase, clinicians interacted with a “patient” and his “sister” (both confederates) in a simulated scenario developed in consultation with health professionals. Clinicians received a brief written statement informing them they would be participating in a simulated scenario, involving a “patient” who had been assessed in the Emergency Department. The statement instructed each clinician to carry out “a head to toe assessment and develop a plan of care so that you can discuss his condition with the surgeon when they arrive... [the patient] had 5 mg morphine (i.v) 2 hours ago, and can’t have any more for another hour.” We chose this scenario because patients admitted to Emergency Departments are often undertreated for pain; thus, a clinician could realistically encounter this situation.[23, 24]

During the interaction—which took place in a simulated Medical Assessment and Planning Unit at a public hospital—the confederates acted out a scripted scenario. The interaction began as soon as the clinician walked into the simulated patient room. The patient lay in a hospital bed, and was fitted with an intravenous drip. Throughout the interaction, the patient writhed in obvious pain, and the sister made it clear she was anxious

about her brother's condition by interrupting the clinician often and demanding more information. The clinician mostly led the interaction, carrying out a head-to-toe assessment of the patient while asking questions such as "When did the pain begin?"

Although the content of the interactions depended somewhat on how the clinicians carried out their assessments, the confederates ensured eight "critical aspects" were introduced during every interaction. Four of these critical aspects were medically-relevant (e.g. time the pain became constant), and four were medically-irrelevant (e.g. sister's name). We included both medically-relevant and medically-irrelevant aspects for two reasons. First, clinicians' experience with medical information might reduce their susceptibility to misleading PEI about medically-relevant aspects compared to medically-irrelevant aspects. Second, witnesses' ability to recall both relevant and irrelevant aspects from an event can influence how triers-of-fact evaluate the credibility of those witnesses.[25] We created these critical aspects in consultation with health professionals (for a complete list of the critical aspects, see Table 1).

Table 1.

Critical Aspects for Script Version 1 and 2

Critical aspect	Version 1	Version 2	Nonspecific
Pain onset	4am	6am	Earlier that morning
Last seizure	2 years ago	2 months ago	A while ago
Medic alert tag	Bracelet	Necklace	Tag
Patient's vital signs	BP (128/78) HR (118)	BP (118/78) HR (128)	(Detail omitted)
Facial hair*	Beard	Beard	Beard
Sister's name	Mackenzie	Maddy	Patient's sister
Sister's shirt	Blue	Cream	Shirt
Piercing	Left ear	Right ear	Ear

Note: For each critical aspect in version 1, the misleading information given was the critical aspect in version 2—with the exception of Facial hair, where the misleading information was "clean shaven." Due to an error in the narrative, the nonspecific aspect for Facial hair was consistent with the aspect presented in both versions of the script. As a result, clinicians who were not misled about this item received information consistent with what they had experienced in the scenario. The patterns of results reported below do not change when we remove this aspect from analysis, so we retain this aspect for the reported analyses.

The nonspecific information was the same for both versions of the script.

There were two scripted versions of the interaction that differed only on the specific

instance of a critical aspect in a particular category. For example, the patient's pain became constant at 4am in one version, and 6am in the other (see Table 1). Half the clinicians participated in one version of the interaction, and half participated in the second version. The interaction ended once the confederates had acted out the entire script. The mean duration of the interaction was 5 minutes 29 seconds ($SD = 1\text{min } 2\text{s}$, range = 2min 36s - 6min 40s).²

Immediately after the interaction, the second phase began. In this phase, the experimenter accompanied the clinician to a private room, and asked him or her to complete an "Emotional Intelligence Questionnaire". This questionnaire was adapted from two online emotional intelligence questionnaires: The Global Emotional Intelligence Test [26] and the Emotional Intelligence Test.[27] This questionnaire was a filler task to create a short delay between a clinician's interaction with a patient and the report of that interaction.

After 15 minutes, the clinicians read an ostensibly personalised report documenting their empathy towards the patient during the interaction. In reality, this report was identical for all clinicians, apart from minor modifications tailored to the clinician's actions. With this tailoring, the reports ranged from 420-427 words. In each report, we embedded misleading information about four critical aspects, and nonspecific (but accurate) information about the other four critical aspects (see Table 1), meaning all clinicians received both misleading and nonspecific PEI. We counterbalanced across all aspects and clinicians so that each critical aspect served as the target of misleading or nonspecific PEI equally often. For example, when the patient said the pain became constant at 4am, clinicians either read that the pain became constant at 6am (misleading PEI) or earlier that morning (nonspecific PEI); when the patient said the pain became constant at 6am, clinicians either read that the pain became

² Although the confederates' dialogue and actions were scripted, each interaction varied slightly, depending on the questions the clinician asked, and the assessments the clinician performed. BR observed each interaction through a one-way window and communicated with the confederates, each of whom wore an earpiece, to provide them any necessary answers to unanticipated medical questions.

constant at 4am (misleading PEI) or earlier that morning (nonspecific PEI). For every version of the report, we misled clinicians about two medically-relevant aspects and two medically-irrelevant aspects. Similarly, we gave them nonspecific information about two medically-relevant aspects and two medically-irrelevant aspects.

After this second phase, clinicians worked on another filler activity—“Reading the Mind in the Eyes”[28]—for approximately 5 minutes 30 seconds. Subjects were told the purpose of this task was to “gather some information about the ways people read emotions in others”—consistent with the cover story. Then the third phase began. In the third phase, clinicians completed a surprise memory test during which they answered 20 two-alternative forced-choice questions about the interaction, including questions about each of the eight critical aspects. For each question, clinicians chose between the version of the aspect they actually encountered in the interaction, and an inaccurate version. For example, if the patient said the pain became constant at 4am, the clinician could choose between 4am and 6am on the test. For half of the critical aspect questions, the inaccurate option had been suggested in the form of misleading PEI in the empathy report. For the other half of the critical aspect questions, the inaccurate option had not been specifically mentioned in the empathy report. After each question, clinicians rated how confident they were about their answer using a 5-point Likert-type scale from 1 (not at all confident) to 5 (very confident).

Immediately after clinicians completed the memory test, the fourth phase began. In this phase, we told clinicians “Instead of having you write out your clinical notes... tell me everything you can remember about your head to toe assessment of [the patient] and his condition.” Once clinicians had given their report, the experimenter probed them for anything else they could remember. These free-recall memory reports were audio recorded.

Session 2. Following the NZ national policy for the initial reporting of patient safety incidents, approximately 15 working days after Session 1 ($M = 15.61$, $SD = 1.19$, range = 14-18) we conducted a follow-up memory test by phone, which was audio recorded. During

this test, clinicians answered cued-recall questions about the eight critical aspects (for example, “What time did [the patient’s] pain become constant?”). If the clinician responded “I don’t know”, or did not provide a plausible answer, the experimenter followed up with the related two-alternative forced-choice question from the memory test in Session 1.

At the end of the experiment, all subjects were thoroughly debriefed.

RESULTS

Accuracy

To address our primary research question about the accuracy of clinicians’ recall of a patient interaction following misleading PEI, we examined clinicians’ performance on the first memory test—which took place approximately 25 minutes after the interaction. To address our prediction of lower accuracy for misled aspects compared to nonspecific aspects of the interaction, we calculated the percentage of correct responses on critical aspects across all clinicians (see left panel of Figure 1). As the left panel shows, shortly after the interaction, clinicians were less accurate in the face of misleading information ($M_{\text{nonspecific}} = 76.92\%$, $M_{\text{misled}} = 48.07\%$). That is, misleading PEI distorted clinicians’ memory reports, producing a raw effect size of 28.85% (95% CI [11.57%, 46.12%]).

Of course, it is possible that given our small sample, this misinformation effect was driven by a few extreme individual scores. But as the inset right-hand panel of Figure 1 depicts, 10 out of 13 clinicians’ memories were distorted by misleading information, a finding showing the demonstrated misinformation effect was not driven by a few extreme scores.

Recall that we tested clinicians’ memories for both medically-relevant and medically-irrelevant aspects from the interaction. To what extent were clinicians less susceptible to misleading PEI for medically-relevant aspects, compared to medically-irrelevant aspects? There were no reliable differences in the extent to which clinicians incorporated misleading information about medically relevant and irrelevant aspects into their report of the

Figure 1. Clinicians' accuracy on misled and nonspecific aspects. The lefthand panel displays the mean accuracy for all clinicians. Error bars represent 95% within-subjects confidence intervals. The inset righthand panel displays mean accuracy for each clinician individually.

interaction (Type of Postevent Information x Relevance: $F(1,12) = 1.35$, $p = .268$, control vs misled raw effect sizes: Medically relevant items $M_{\text{diff}} = 23.10\%$, 95% CI [7.40%, 38.80%], medically irrelevant items $M_{\text{diff}} = 42.30\%$, 95% CI [12.48%, 72.10%]). The large confidence intervals around these means suggest that our experiment was not sufficiently powered to detect an effect of medical relevance. Nevertheless, the results provide tentative support for the conclusion that clinicians incorporate misleading information about both medically relevant and irrelevant aspects into their reports of interactions.

Confidence

To address our prediction that clinicians would be confident in their memories of misleading PEI, we compared clinicians' confidence ratings for their answers to questions about misled aspects to their confidence ratings for their answers to questions about nonspecific aspects, and display these data in Figure 2. As the figure shows, clinicians were similarly confident that their answers to questions about both misled and nonspecific aspects were correct ($M_{\text{misled}} = 2.83$, $M_{\text{nonspecific}} = 2.44$; raw effect size = 0.38, 95% CI [-0.09, 0.86]), despite their answers about misled aspects being less accurate. At the individual level, this pattern of results held true for 11 out of 13 clinicians. Taken together, these results suggest that clinicians mistakenly, yet confidently, adopted the misleading PEI.

Figure 2. Clinicians' mean confidence in their answers to questions about nonspecific and misled aspects. Error bars represent 95% within-subjects confidence intervals. The inset righthand panel displays mean confidence for each clinician individually.

Free recall

Given that clinicians confidently adopted the misleading PEI, we now turn to their free recall reports to investigate the extent to which clinicians voluntarily reported misleading PEI. Authors AT, CBW, and RB transcribed the clinicians' free recall reports. Overall, these reports were brief ($M = 534$ words, 95% CI [343, 725]). Only four clinicians mentioned any critical aspects in their free recall reports, so we are unable to draw any reliable conclusions

about the extent to which clinicians voluntarily reported the misleading PEI³.

Delay

We now turn to the question of clinicians' accuracy after a longer delay. AT, CBW, and RB transcribed and independently coded the audio recordings of the memory test from Session 2. Because this second memory test was a cued-recall test, clinicians were no longer forced to choose between two alternatives and could provide any answer. For each of the eight critical aspects, each coder marked the clinician's response as accurate or inaccurate (depending on the version of the interaction the clinician had experienced). For example, if the patient's pain had become constant at 4am, the answer "4am" would be considered accurate, but "6am" or "mid-morning" would be considered inaccurate. Inter-coder agreement was 88.46%, and all disagreements were resolved through discussion.

To what extent can clinicians accurately recall aspects of an interaction with a patient after 15 working days? As Figure 3 shows, accuracy for critical aspects was very low. This floor effect, combined with a small sample, made it difficult to address our prediction that clinicians would mistakenly report the misleading PEI three weeks later. But in absolute terms, clinicians gave accurate answers to questions about misled aspects less often than they did to questions about nonspecific aspects ($M_{\text{misled}} = 11.54\%$, $M_{\text{nonspecific}} = 21.15\%$, raw effect size = 9.62%, 95% CI [-3.52%, 22.75%]⁴).

For any cued-recall questions to which clinicians responded "I don't know", or gave an implausible answer ($M = 4.61$, $SD = 1.66$), the experimenter followed up with the related two-alternative forced-choice question from the memory test given in Session 1. We then calculated clinicians' accuracy at the three-week delay, coding responses as accurate if

³ In total clinicians mentioned misled aspects five times, four of which were correct, and nonspecific aspects nine times, five of which were correct.

⁴ We also coded responses a second time. This time, we were more liberal with the range of answers we accepted as accurate. Even with a liberal coding scheme, overall accuracy for critical aspects was low ($M = 25.96\%$, $SD = 19.41\%$) and was similar between information type ($M_{\text{nonspecific}} = 32.69\%$, $M_{\text{misled}} = 19.23\%$, raw effect size = 13.46%, 95% CI [-2.40%, 29.32%]).

clinicians gave the right answer to either the cued-recall question, or the follow-up forced-choice question. Even when we included clinicians' responses to the forced-choice questions, overall accuracy for critical aspects was low ($M = 41.34\%$, $SD = 20.66\%$). Furthermore, clinicians were less accurate for misled aspects compared to nonspecific aspects, but the wide confidence intervals make it difficult to draw strong conclusions from these data ($M_{\text{nonspecific}} = 48.08\%$, $M_{\text{misled}} = 34.62\%$; raw effect size = 13.46%, 95% CI [-34.48%, 7.56%]). Taken together, these results suggest that after 15 working days clinicians' reports of the event were markedly inaccurate.

Figure 3. Clinicians' accuracy on misled and nonspecific aspects at the 15 day test. The lefthand panel displays the mean accuracy for all clinicians. Error bars represent 95% within subjects confidence intervals. The inset righthand panel displays mean accuracy for each clinician individually. Missing bars indicate that the clinician was not accurate about any tested aspect of the interaction.

DISCUSSION

In this study, we examined the extent to which clinicians can accurately recall aspects of an interaction with a patient in the face of misleading PEI. We found clinicians were less accurate when we misled them about certain aspects of their interaction with a patient—yet they were similarly confident about their memory for misled and nonspecific aspects. Furthermore, after 15 working days, clinicians' had poor memory for the tested aspects of their interaction. Taken together, these results suggest that reports of patient safety incidents

could plausibly be compromised by misleading PEI.

Strengths and Limitations

We applied the established misinformation effect paradigm to a novel and important real-life context: clinicians' interactions with patients. In consultation with health professionals, we designed a scenario that clinicians could realistically encounter, and one that might plausibly escalate in seriousness. Furthermore, we drew our sample from clinicians currently working in the public hospital system, all of whom had experience interacting with and treating patients. In taking these steps, we created a realistic scenario.

Due to the logistical issues involved in using a realistic scenario and a sample of clinicians, we had difficulty recruiting clinicians to participate in the experiment. In part, this difficulty arose because we had limited access to the simulation centre at the hospital, and clinicians' schedules often clashed with the times we could access the centre. As a result, our sample size ($n=13$) is obviously small. A problem inherent in small samples is that any observed effect may be the product of the idiosyncrasies of the group. Nevertheless, our findings here are consistent with the vast literature carried out over more than four decades documenting the misinformation effect.[6-10, 19-22, 29-31]

Another limitation of our design is that our scenario differed in an important way from real-life interactions with patients: clinicians were not allowed to write notes during or after their assessment. Written notes provide a contemporaneous, external record of the interaction, and might act as a cue to aid clinicians' later recall of the interaction. In addition, if clinicians have adopted misleading information, they might be able to correct that information by referring to their earlier written notes. Because we did not afford the clinicians this opportunity, our method might overestimate the extent to which clinicians are susceptible to misleading PEI in real-life interactions with patients. But that possibility assumes that clinicians take complete and accurate notes. In fact, clinicians' notes do not always contain all the crucial information about a patient's care—and even when those notes

are detailed, that detail is not always accurate.[15, 17] Therefore, even in real-life situations in which clinicians are able to take notes, those notes may not confer protection from memory distortion.

One final limitation of our study is that in real-life interactions with patients, clinicians might pay more attention to the details of those interactions compared with the attention they paid to critical aspects in our experiment. After all, clinicians were aware the patient was not actually in pain. Thus, if clinicians were less engaged than they would be in a real-life interaction, then they might remember real-life interactions more accurately than our results suggest. Are we therefore underestimating clinicians' ability to remember real-life interactions with patients while at the same time overestimating their susceptibility to misleading information? In addition, we could not ensure that clinicians directed their attention to every critical aspect because the precise details of the interaction depended on how each clinician approached the task of the head to toe assessment. Finally, by telling clinicians we were interested in empathy, perhaps we prompted them to pay attention to the interpersonal aspects of the interaction at the expense of the aspects we tested.

Although we cannot preclude these three possibilities, there is evidence that clinicians were engaged and paid attention throughout the interactions: they had good memory (77%) for the nonspecific aspects of the first memory test. By contrast, a lack of engagement and (or) attention should have led to poor memory, perhaps even at chance. Furthermore, when the clinicians' recounted the interaction, many comments suggested they were absorbed in the scenario and took it seriously. For example, one clinician reported "I desperately wanted to give him some more morphine...and wanted to get out of there."

Implications for policy and research

Our experiment is, to the best of our knowledge, the first empirical demonstration that clinicians are susceptible to misleading suggestions about their interactions with patients, even after only a short delay. These findings highlight the fragility of clinicians' memory

and the pervasiveness of memory errors.

Our findings, when considered with the vast supporting literature on the effects of misleading information, suggest it is important that patient safety incident reports be made as soon as possible—that is, before talking with colleagues about the incident or seeing the next patient. Moreover, our findings suggest both the UK and NZ maximum delays for submitting patient safety incident reports are too long, and are an obstacle to identifying the true causes of medical errors.

Of course, we recognise that it is not always possible for clinicians to make reports immediately after their interactions with patients—such as when immediate medical intervention is necessary or a medical incident is discovered only after a delay. When delayed reporting is unavoidable, a variety of well-validated eyewitness interviewing techniques might help to promote accurate and detailed recall. For example, when reporting patient safety incidents, clinicians should first have the opportunity to freely recall everything they remember about the incident. Following this free recall, specific questions can further probe clinicians' memory.[32] Clinicians should also be encouraged to mentally place themselves back in the incident while recalling it.[32, 33] Patient safety incident reporting forms could be designed to make use of these techniques to maximise the amount of accurate information that clinicians report. Regardless of the extent to which these techniques are adopted, the detrimental effects of delay should be considered when evaluating the accuracy of delayed accounts of patient safety incidents.

Conclusion

Our primary aim was to determine the extent to which clinicians can accurately recall aspects of an interaction with a patient in the face of the misleading PEI. We found support for the prediction that clinicians would incorporate misleading information into their memory for an interaction with a patient. Specifically, clinicians were less accurate when we misled them about certain aspects—yet they were similarly confident about their memory

for that information as they were for aspects about which we did not mislead them.

Furthermore, after 15 working days—the maximum time NZ clinicians have to submit their initial patient safety incident reports—memory for the tested aspects of the interaction was poor. Taken together, these results suggest that, even after a short delay, reports of patient safety incidents could plausibly be compromised by misleading PEI. In turn, delays between patient safety incidents and the reporting of those incidents could compromise our ability to understand the true causes of medical errors.

Figure legends:

Figure 1. Clinicians' accuracy on misled and nonspecific aspects. The lefthand panel displays the mean accuracy for all clinicians. Error bars represent 95% within-subjects confidence intervals. The inset righthand panel displays mean accuracy for each clinician individually.

Figure 2. Clinicians' mean confidence in their answers to questions about nonspecific and misled aspects. Error bars represent 95% within-subjects confidence intervals. The inset righthand panel displays mean confidence for each clinician individually.

Figure 3. Clinicians' accuracy on misled and nonspecific aspects at the 15 day test. The lefthand panel displays the mean accuracy for all clinicians. Error bars represent 95% within subjects confidence intervals. The inset righthand panel displays mean accuracy for each clinician individually. Missing bars indicate that the clinician was not accurate about any tested aspect of the interaction.

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