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ARTICLE

Virtual reality evidence on the impact of physicians' open versus defensive communication on patients

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Abstract

Using virtual reality (VR) in an experimental setting, we analyse how communicating more openly about a medical incident influences patients' feelings and behavioural intentions. Using VR headsets, participants were immersed in an actual hospital room where they were told by a physician that a medical incident had occurred. In a given scenario, half of the participants were confronted by a physician who communicated openly about the medical incident, while the other half were confronted with the exact same scenario except that the physician employed a very defensive communication strategy. The employed technology allowed us to keep everything else in the environment constant. Participants exposed to open disclosure were significantly more likely to take further steps (such as contacting a lawyer to discuss options and filing a complaint against the hospital) and express more feelings of blame against the physician. At the same time, these participants rated the physician's communication skills and general impression more highly than those who were confronted with a defensive physician. Nevertheless, communicating openly about the medical incident does not affect trust in the physician and his competence, perceived incident severity and likelihood of changing physician and filing suit.

Keywords: communication; medical incident; medical liability; open disclosure; virtual reality

JEL Classification: I11; I18; K32

1. Introduction

Each year, approximately 400,000 patients die worldwide from unintended harm caused by care, or so-called medical incidents (James, 2013). When confronted with medical incidents, physicians' fear of complex (legal) unfolding procedures (Bielen *et al.*, 2019, 2020) may drive them to a rather defensive or non-open communication towards patients and their relatives (i.e. hiding information, avoiding responsibility, showing no empathy and lacking openness for further questions) (Blendon *et al.*, 2002; Gallagher *et al.*, 2006). However, multiple empirical studies suggest that open communication about incidents (being empathic, honest and sincere, taking responsibility, providing information about the incident, possible compensation and corrective actions) would lead to fewer lawsuits and better patient perceptions (Mazor *et al.*, 2006; Nazione and Pace, 2015). Unfortunately, many studies suffer from endogeneity issues. Moreover, many studies focus on guidelines about, for example, expressiveness or eye contact, which are open to interpretation and are difficult to implement in practice. Studies also commonly address clear physician mistakes, while physicians' responsibility for the incident is mostly unclear during initial incident conversations.

In the present paper, we overcame these shortcomings by using virtual reality (VR) techniques in an experimental setting. We showed participants 360° videos of physicians saying that a medical incident occurred and manipulate the verbal (i.e. what is said in the conversation) aspects of physicians' communication (hereafter called treatment), rather than body language. We focus

on cases in which responsibility for the incident is unclear in the open videos and attributed to the patient in the defensive videos. After each video, we ask the participants how they perceived the physician and the incident and how likely they were to engage in further steps, such as filing suit or changing physician.

The set-up allows us to hold everything except the treatment (body language, hospital room, clinical indications, etc.) constant. In other words, while one participant watches the conversations where the physicians communicate openly about the medical incidents, another participant is asked to watch the exact same consultations, with the same physicians, the same non-verbal actions, the same medical incidents, except that the physicians communicate defensively in one specific part of the conversations. By creating arguably perfect counterfactuals, we can answer the question of whether physicians' verbal communication about a medical incident impacts patients' perceptions and willingness to (legally) hold the physician accountable for the caused harm.

While the external validity of experiments is generally low, using VR technology mitigates the problem. We made use of 360° cameras to shoot hypothetical medical incident conversations with real physicians in a real hospital setting. These videos are implemented in VR headsets (Oculus Rift headsets) so that, by putting on the headsets, participants are 'immersed' in a consultation where they lie in a hospital bed and are told by the physician that an incident has occurred. In this manner, unlike in video- or paper-based experiments, patients are not distracted with sensorial stimuli in the room and can easily imagine an environment when being in the PC lab. Because the camera was positioned from the patients' perspective (in the hospital bed), the participants can look around in the hospital room as real patients would do, feeling that they are really 'present' in the hospital room and feeling part of the consultation. As studies have shown that perceived reality with VR is better than 2D videos (Slater and Wilbur, 1997) and written scenarios (Van Gelder *et al.*, 2019), the VR technology in an experimental setting adequately addresses the issue of internal validity, at the same time as mitigating the external validity concerns relative to the alternative approaches used in the literature (Blascovich *et al.*, 2002). Furthermore, research has indicated that using VR enhances the focus (Patterson *et al.*, 2017) and decision-making of participants in choice experiments (Mokas *et al.*, 2021). To the best of our knowledge, VR has never been used before in this research area.

Our results reveal that, in contrast to existing literature, open disclosure leads to higher intentions to contact a lawyer to discuss their options and complain to the hospital and to higher reported feelings of blame against the physician. Nevertheless, there are no differences in participants' intentions to file suit or change physician, the trust they have in the physician and his competence, and in the perceived incident severity. The participants' general impression of the physician and his communication skills is even better in the open scenarios than in the defensive counterparts.

The rest of the paper is organised as follows. Section 2 discusses the related literature. Section 3 describes in detail the experiment set-up, production and validation process of the VR videos and sample selection methods. Our empirical results are presented in sections 4 and 5 and discussed in section 6. Section 7 concludes.

2. Related literature

Using physicians' audiotapes and their malpractice history, Levinson *et al.* (1997) and Ambady *et al.* (2002) showed that sued physicians communicate differently with patients than non-sued physicians, raising the question of whether physicians' communication style drives patients' intention to sue. Since then, several scholars have examined potential relationships. First, some researchers have exploited the implementation of open disclosure guidelines to perform before-and-after analyses. Open disclosure is defined as 'a process in order to acknowledge and redress emotional, physical, and financial harm, express an ethic of continuing care for the patient, and restore trust after a medical incident' (Moore *et al.*, 2017). Kachalia *et al.*

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(2010, 2018) found that open-disclosure programmes correlate negatively with the number of new claims.

Second, many researchers have organised focus groups or surveys to question physicians and/or patients about their perception on incident communication, describing the needs of patients, physicians and institutions in case of a medical incident (Gallagher *et al.*, 2003; Iedema *et al.*, 2011; Hannawa *et al.*, 2013).

A third strand of literature employed an experimental approach in which people are shown videos or scripts of hypothetical physician–patient dialogues after a medical incident and are asked about their thoughts, feelings and behavioural intentions. For example, Mazor *et al.* (2006) used this method to show that open disclosure after a medical incident lowers liability risk. However, they did not present a sufficiently large sample size to ensure high power of the study results regarding four design variables (existence of a positive prior relationship, severity of clinical outcome, level of disclosure and an offer to waive costs). Similarly, Nazione and Pace (2015) attempted to address the role of apology, empathy, corrective action and compensation in patients' intentions after error disclosure. That study found that apologies do not result in greater feelings of responsiveness against physicians and that empathy, in contrast to corrective action and compensation, leads to substantially less anger and negative behavioural intentions. However, the authors were not able to report successful manipulation checks and the sample size was relatively small to ensure clear causal effects for the multiple manipulations in the study design. The same sample issues are prevalent in the study of Wu *et al.* (2009), who suggested that full apology and responsibility result in significantly higher feelings of trust and referral intentions, but found no differences in intention to sue. Similarly, Allan *et al.* (2015) showed that participants watching videos of a surgeon apologising for an adverse event focusing on patients' needs evaluated the apology as more sincere and as denoting greater regret than in case of a self-focused apology. In addition to the fact that this study solely focused on one aspect of open disclosure (i.e. apology formulation), the authors could not guarantee that duration differences confounded the results.

Apart from empirical research on the impact of verbal communication, scholars have focused on communication style (i.e. kindness, humour and eye contact). Using a randomised controlled trial, Hannawa (2011, 2014) proved the importance of non-verbal involvement in communicating incidents. Using video-taped and paper-based transcripts of hypothetical consultations, Lester and Smith (1993) and Moore *et al.* (2000), respectively, found that a negative communication style during treatment increases the probability of a malpractice lawsuit. However, the studies' scopes are limited to communication during medical treatments instead of during disclosing incidents.

The present paper contributes to the existing literature in three ways. First, we ensure high power of the study results by using an experimental design with only one manipulation (a generally open vs. defensive verbal communication). By keeping all other factors constant, we are able to isolate the effect of verbal from non-verbal aspects of incident communication. Second, we use VR techniques to improve the external validity of the experiment. Third, to the best of our knowledge, this is the first study to focus on scenarios regarding initial incident disclosure in which uncertainty exists in physicians' responsibility in the open versions and the patient is blamed for the incident in the defensive versions.

3. Design and methods

3.1 Scenarios

Each participant watched three VR videos regarding a follow-up consultation after a harmful medical incident; the videos featured the treating physician, the patient and a friend or family member in a hospital room. In each video, the physician explained that there was a medical incident and answered a question from the patient's visitor about the medical procedures that were

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necessary to resolve the harm the incident caused. To avoid participants having difficulty empathising with the patient in the videos, for example, regarding to voice or gender, the patient does not say anything during the conversation. Also, we did not use names, gender, age and other demographics for the patients in the scenarios and chose general cases (e.g. we did not choose any gynaecological cases because they are only applicable to women). The videos are related to anaesthetics (two videos) and general surgery (one video), as these are high-risk specialities and hence harmful medical incidents are common (Lawthers *et al.*, 1992; Studdert *et al.*, 2005; Jena *et al.*, 2011). We shot only the initial conversation after the incident, as Moore *et al.* (2017) showed that this determines the further course of the unfolding of the incident. Based on initial discussions with physicians, we know that such conversations normally last between 5 and 15 min. Our videos are no longer than 5 min for practical reasons.

We manipulated the physician's message. We have one version of each case in which the physician communicates openly (observed by the treatment group) and another in which he communicates defensively (observed by the control group). We based our scripts and manipulations on a qualitative study of prior scripted studies in open disclosure/communication literature (Mazor *et al.*, 2004; Gallagher *et al.*, 2007; Levinson, 2009; Allan and McKillop, 2010; Iedema *et al.*, 2011; Hannawa, 2012; Hannawa *et al.*, 2013; Wu *et al.*, 2013; Mello *et al.*, 2014; Allan *et al.*, 2015; Moore *et al.*, 2017), and the expertise of 33 field experts (hereafter, expert panel).[1] More specifically, we conducted interviews with the field experts to review existing literature and discuss the major and most common distinctions between open and defensive communication. Differences between open and defensive communication are defined in the following aspects of physicians' verbal communication: (1) responsibility (patient's responsibility vs. summary of objective potential causes of the incident), (2) empathy (little vs. more empathy), (3) information (limited vs. extensive information about what happened), (4) honesty/sincerity (self-assured vs. expression of uncertainty), (5) corrective action (no intention vs. intention for correction action mentioned), (6) communication skills (limited vs. elaborated), (7) compensation (no offer vs. offer for compensation mentioned) and (8) openness to further questions (no openness vs. openness to further questions showed). These elements are manipulated simultaneously, given that they are together considered as the most important differences between open and defensive communication. The aim of this paper is not to disentangle the effect of these different verbal aspects of communication, but rather to analyse the impact of a more open communication more generally (in terms of all eight communication characteristics) versus a more defensive communication. Table 1 summarises the manipulations for a scenario about an accidental dural puncture. Full transcripts of the videos can be requested from the author.

Two important features of our design ensure that the scenarios with defensive communication are suitable counterfactuals for the ones demonstrating open disclosure. First, by design, everything unrelated to the physician's communication is held constant. That is, the physician, the patient's health status and care path, the adverse outcome, the environment, the friend/family member (and what he says and does) and everything else that is observed by the participant are exactly the same in the two versions of a given scenario. This is because we shot one version of each scenario, and subsequently only replaced the manipulated dialogue of the physician. Second, one might argue that physicians who engage in more defensive communication feature other characteristics in communication style (unrelated to what is said) that could explain possible differences in patient reactions. For example, more defensive physicians might be more likely to use a different tone of voice (e.g. less vocal animation and relaxation) or exhibit specific non-verbal behaviour (such as less smiling or less immediacy, with a forward lean and

[1]We collaborated closely with ten physicians, three nurses, two health care managers, seven scholars, three lawyers, one patient, one member of the Flemish Patient Platform, one health insurance expert, three ombudsmen and two quality coordinators.

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Table 1. Manipulations scenario, accidental dural puncture

Manipulated element	Defensive communication	Open communication
Responsibility	Patient's responsibility *Example: In your case, it was very difficult to puncture for epidural anaesthesia because you were moving while the needle was inserted.*	Summary of objective potential causes of the incident *Example: Factors that may contribute to such an event include a back disorder such as osteoarthritis, or movement, that makes puncturing more difficult.*
Empathy	Little empathy *Example: You now have more pain than expected, but that is a known risk of anaesthesia.*	More empathy *Example: It is very unfortunate that this has happened and we understand that this causes you more trouble than expected, for which we would like to apologize.*
Information	Limited information about what happened *Example: In your case, it was very difficult to puncture for epidural anaesthesia and therefore the puncture was too deep. This causes a severe headache.*	Extensive information about the incident as such *Example: Because the puncture was too deep, a hole has formed in the membrane around the spinal cord. This causes some fluid to leak into the cavity between the membrane and the vertebrae. Therefore, there is a change in pressure, which causes a severe headache.*
Honesty/sincerity	Self-assured *Example: Of course, everything is done to avoid this, but that was not possible in your case.*	Expression of uncertainty *Example: However, we are not sure how this could have happened to you.*
Corrective action	No intention for corrective action mentioned	Intention for corrective action mentioned *Example: We will do everything we can to resolve this problem as soon as possible and investigate how we can avoid such events in the future.*
Communication skills	Limited *Example: We are going to solve this quickly, so you don't have to worry.*	Elaborated *Example: I would like to give you more information about the incident, if that's okay with you.*
Compensation	No offer for compensation mentioned	Offer for compensation mentioned *Example: We have already notified our insurance company about this incident.*
Openness for further questions	No openness for further questions showed	Openness for further questions showed *Example: Of course, you can always contact me if you have any questions.*

appropriate touch).[2] However, the aim of this paper is to analyse the impact of a message related to a medical incident that is characterised as non-defensive in substance (such as summarising objective potential causes of the incident, expressing openness for further questions and the intention for corrective action) and holding constant the aforementioned non-verbal behaviour. Therefore, the defensive and open communication videos of a specific case were roleplayed by the same physician, who was asked to act out the defensive and open parts of the conversations in order so that their position was the same in both versions of the videos. To mitigate further

[2]Hannawa (2014) showed that non-verbally uninvolved error disclosure affects perceived incident severity and patient understanding.

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concerns of changing non-verbal behaviour, we followed Pingitore *et al.* (1994) and (1) thoroughly trained the participating physicians to keep vocal intonation, body movements, gestures and posture the same in all conditions, (2) closely monitored and directed the participating physicians to make sure non-verbal behaviour was very similar in the two versions of the video, (3) shot each scene multiple times, allowing us to select and edit the shots that were most comparable with respect to non-verbal behaviour.

3.2 Production of the videos

A professional VR production firm was hired to shoot the scripted scenarios with high-quality sound and vision. The videos were shot with a static 360° camera. The technicians were not allowed in the hospital room; they followed the footage and the accompanying sound on iPads with headsets in the corridor. The camera perspective was the patients' point of view. To achieve this, the camera was positioned on top of a mannequin (i.e. where the head would be), lying in a hospital bed. Because the majority of all specialists in Belgium are male (Roberfroid *et al.*, 2008), we asked three male physicians to roleplay the physicians in the videos.[3] The patient's visitor was impersonated by a single male actor in the three scenarios. The videos were recorded in a real hospital room in Lanaken, Belgium.

3.3 Validation of the videos

To ensure that physicians' verbal behaviour was distinguishable in the open and defensive version of each scenario, we first asked 90 people to rate the verbal aspects of the written scenarios and then asked another 30 to rate the VR videos. We followed the recommendations of Van Vliet *et al.* (2013) to pilot-test both media (text and videos), as the medium may alter participants' perceptions. A double pilot test also allowed us to check whether preliminary changes after the first pilot round had been successful. After a validated translation,[4] survey items from the literature were used to check all manipulations on seven-point Likert scales. Specifically, we asked respondents about the extent to which they agree (1 = completely disagree to 7 = completely agree) with various statements about (1) feelings of blame and fault (12 items) (Moore *et al.*, 2000; Coombs and Holladay, 2002; Nazione and Pace, 2015), (2) empathy (five items) (Coke *et al.*, 1978; Hannawa *et al.*, 2016), (3) information (six items) (Schoenfeld *et al.*, 2019), (4) honesty/sincerity (four items) (Brugel *et al.*, 2015), (5) communication skills (12 items) (Jonas *et al.*, 1992; Schulman *et al.*, 1999; Rollnick *et al.*, 2001; Gerbert *et al.*, 2003; Wu *et al.*, 2009), (6) compensation (two items) (Nazione and Pace, 2015), (7) corrective action (two items) (Hannawa, 2011; Nazione and Pace, 2015) and (8) openness for further questions (two items). All manipulations were perceived as intended at the 5 per cent significance level. That is, participants who saw the open disclosure videos placed less blame on the patient for the incident, experienced more empathy, more information, more honesty/sincerity, better communication skills of the physician, a belief in compensation, corrective actions and openness to further questions. Interestingly, and as hypothesised, perceived differences between the open and defensive conversations were more pronounced in the VR videos than in the written scenarios because of the immersiveness related to VR.

We also used seven-point Likert scales to assess the realism of (1) the physician, (2) the patient's visitor, (3) the conversation, (4) the medical consultation, (5) the medical incident, (6) the hospital room and (7) the length of the conversation (Willson and McNamara, 1982; Shapiro *et al.*, 1992; Aruguete and Roberts, 2000, 2002; Roberts and Aruguete, 2000; Bradley *et al.*, 2001; Strasser *et al.*, 2005; Verheul *et al.*, 2010; Hillen *et al.*, 2013; Schoenfeld *et al.*,

[3]We did not include female physicians because the sample sizes would have been too small to disentangle possible gender effects.

[4]Following the method of Cha *et al.* (2007).

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2019). Participants rated the realism of all elements, except for the patient's visitor, significantly higher than the scale centre of four (5 per cent significance level).[5]

The same seven-point Likert scale was used to measure participants' ability to empathise with the patient (Green and Brock, 2000; Hillen *et al.*, 2013) and the understandability and clarity of the scripts and the videos. All of these items were found to be higher than the scale centre of four (5 per cent significance level). A content check with three open questions was also successful. Based on additional open-ended remarks on the written scenarios, we included more information about the recovery process and the reporting of the incident to the insurance company in the final open VR videos.

3.4 Sample and procedures

Randomly selected economics, medicine and physiotherapy students at Hasselt University participated in the final experiment. The participants were not aware of the goal of the study and did not need to have experience with the conditions in the scenarios. Several studies have indicated that answers of analogue patients are representative for those of real patients and that they are equally engaged in watching video vignettes (Van Vliet *et al.*, 2012; Visser *et al.*, 2016). Following the power analysis for multivariate regression analysis of Dupont and Plummer (1998) with a desired statistical power level of 90 per cent, the number of included variables and a probability level of 0.05, we aimed for a sample size of at least 120 participants. In order to obtain a sufficiently large sample, we spread an announcement via mail at Hasselt University, and participants were entitled to a €10 voucher or a movie ticket.

Each participant was randomly assigned to a sequence of three videos with the same communication style: open or defensive. That is, randomisation happened at the participant level. We follow Charness *et al.* (2012) in using a between-design above a within-design to ensure a high number of observations while avoiding confounds and spurious effects. We varied the order of the videos to avoid bias due to order effects. Oculus Rift headsets were used to watch the videos in a PC lab. There was no interaction between the participants during the experiment. After watching each video, participants were asked to fill out a short online questionnaire about their feelings and behavioural intentions. At the end of the experiment, questions were asked about socio-demographics and background. A webpage guided participants through the experiment. It took an average of 35 min for the participants to complete the experiment.

3.5 Key variables

Table 2 provides definitions of the key variables. As the table shows, we combine multiple items into five dummy outcomes. The Cronbach's alphas for the constructs are all at least 0.8. All the items were originally measured on seven-point Likert scales. We have five outcome variables. Our first outcome is the variable further steps, which is a dummy equal to one if the respondent gave a mean score higher than 4 on a seven-point Likert scale to how likely they are to take five behavioural intentions (i.e. intentions to file a lawsuit, to contact a lawyer to discuss options, to complain to the hospital, to discuss the situation with a general practitioner and to change physician) (1 = very unlikely, 7 = very likely) (Mazor *et al.*, 2004, 2006; Grégoire *et al.*, 2009; Nazione and Pace, 2015; Schoenfeld *et al.*, 2019). Second, we measured feelings of blame against the physician, following the study of Coombs and Holladay (2002). Third, we combined three constructs into the variable physician ratings, namely: (1) the general impression of how the physician handles the incident (Wu *et al.*, 2009), (2) physician's competence (two items) (Saha and Beach, 2011) and (3) trust in physician (seven items) (Anderson and Dedrick, 1990). Our fourth outcome is communication skills, constructed of physician's empathy (four items) and sincerity (two

[5]In general, scores were higher for the VR videos than for the written scenarios, except for the patient's visitor and the length of the vignettes.

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Table 2. Variable definitions

Variable name	Description
Outcomes	
Further steps	Dummy equal to 1 if the mean of 5 behavioural intentions (that is, intentions to file a lawsuit[a], to contact a lawyer to discuss options[b], to complain to the hospital[c], to discuss the situation with a general practitioner[d] and to change physician[e]) is greater than or equal to 4 on a seven-point Likert scale.
Feelings of blame	Dummy equal to 1 if feelings of blame against physician[f] are greater than or equal to 6 on a seven-point Likert scale.
Physician ratings	Dummy equal to 1 if the mean of trust in physician[g], general impression of the physician[h] and physician competence[i] is greater than or equal to 5 on a seven-point Likert scale.
Communication skills	Dummy equal to 1 if the mean of physician empathy[j] and sincerity[k] is greater than or equal to 5 on a seven-point Likert scale.
Incident severity	Dummy equal to 1 if incident severity[l] is greater than or equal to 5 on a seven-point Likert scale.
Treatment variable	
Open disclosure	Dummy equal to 1 if student saw open disclosure videos.
Student characteristics	
Male	Dummy equal to 1 if student is male.
Health	General health measured on a 7-point Likert scale from 1 = very bad to 7 = very good.
Med/physio student	Dummy equal to 1 if student follows a medicine of physiotherapist education.
Parent in health/ law	Dummy equal to 1 if parent(s) works/ever worked in healthcare/law.
Incident experience	Dummy equal to 1 if student is ever confronted with a medical incident.

[a]How likely are you to contact a lawyer to file a lawsuit regarding your hospital visit? (1 = very unlikely, 7 = very likely).
[b]How likely are you to contact a lawyer to discuss your complaint and your options regarding your hospital visit? (1 = very unlikely, 7 = very likely).
[c]How likely are you to send a complaint to the hospital about your hospital visit (such as an email, letter or phone call to patient relations)? (1 = very unlikely, 7 = very likely).
[d]How likely are you to talk to your primary care physician about the care you received at your hospital visit? (1 = very unlikely, 7 = very likely).
[e]How likely are you to change physicians? (1 = very unlikely, 7 = very likely).
[f]To what extent do you agree with the following statement about the medical incident discussed in the video? (1 = completely disagree, 7 = completely agree).

- The blame for the incident lies with the physician.

[g]To what extent would you agree with the following statements if you were the patient in the video? (1 = completely disagree, 7 = completely agree).

- I would trust the physician so much that I would always try to follow his advice.
- I would distrust the physician's opinion and would like a second one
- I would feel the physician is not doing everything he could for my medical care
- I doubt that the physician really cares about me as a person.
- I would trust the physician to tell me if a mistake was made about my treatment.

[h]What is your general impression of how the physician handles the incident? (1 = very bad, 7 = very good).
[i]To what extent would you agree with the following statements if you were the patient in the video? (1 = completely disagree, 7 = completely agree).

- I would let the physician treat me further.
- The physician didn't seem very competent to me.

[j]To what extent do you agree with the following statements about the physician in the video? *(1 = completely disagree, 7 = completely agree).*

- The physician is gentle.
- The physician is warm.
- The physician is concerned.
- The physician is compassionate.

[k]To what extent do you agree with the following statements about the physician in the video? *(1 = completely disagree, 7 = completely agree).*

- The physician seems to withhold information from me.
- The physician seems to mean what he says.

[l]To what extent do you agree with the following statements about the medical incident discussed in the video? *(1 = completely disagree, 7 = completely agree).*

- The incident was severe.
- Much harm was done by this incident.

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items) (Coke *et al.*, 1978; Brugel *et al.*, 2015). Fifth, we used two items to assess perceived incident severity (Grégoire *et al.*, 2009; Joireman *et al.*, 2013; Nazione and Pace, 2015). We also included questions to control for participants' socio demographics and legal and health background.

4. Descriptive statistics

One hundred and forty students participated in the experiment, generating a sample of 420 observations. Table 3 shows descriptive statistics of the outcomes and student characteristics. Most of the participants (63 per cent) were female and had relatively good general health (mean of 6.06 on a seven-point Likert scale). Almost half of the sample (46 per cent) followed a medical or physiotherapist education and almost one-third (31 per cent) had a parent who currently works or has worked in health or law (31 per cent). Consistent with existing research (Mazor *et al.*, 2004; Hannawa, 2014), almost one-third of respondents (31 per cent) indicated that they have been confronted with a medical incident as a patient or as a friend/family member.

Thirty-seven per cent of the sample intends to take further steps after the conversations, which is our primary outcome. More than a quarter (27 per cent) of the respondents reported high feelings of blame against the physician, but good communication skills (27 per cent). Thirty-eight per cent of the sample rated the physician relatively high on his competence, trust and general impression (38 per cent) and experiences the incident as severe (37 per cent).

Because participants were randomly assigned, there should be no systematic differences between participants in the control and treatment group. Nevertheless, to check for balance, we performed a series of ordinary-least-squared (OLS) regressions, one per participant characteristic, with open disclosure as the explanatory variable. Table 4 indicates that these balance checks reveal no statistically significant differences between the treatment and control group.

Table 5 presents the descriptive statistics of the outcomes by communication style in the videos (defensive vs. open). For example, row (1) indicates that intentions to take further steps are 10 percentage points higher in case of open disclosure (0.42 vs. 0.32) and that the difference is statistically significant from zero. There are also significant greater feelings of blame against the physician for the treatment group in row (2) (0.35 vs. 0.20). Interestingly, there is no significant difference in physician ratings [row (3)] or perceived incident severity [row (5)]. The treatment group rates physician communication skills significantly higher (0.31 vs. 0.23), as can be seen in row (4).

5. Econometric analysis and results

5.1 Empirical strategy

To examine the impact of open disclosure on patients' feelings and behavioural intentions, we estimated the following equation.

$$Y_{ic} = \alpha + \beta Open\ Disclosure_i + X_i\Theta + \varphi_c + \varepsilon_{ic} \quad (1)$$

where Y_{ic} is one of the various indicators of the feelings and intentions (e.g. intentions to take further steps, feelings of blame, physician ratings) of participant i in case c (each participant encountered three videos). We controlled for a set of participant characteristics (vector X_i) that would be crucial when using observational data since participants may embody attributes that confound the results. This should not be a concern in our research because, by design, physicians' communication type is orthogonal to participant characteristics. Nevertheless, we control for gender, health status, whether the participant is a medicine or physiotherapist student, whether the participant has a parent (has been) working in health or law and incident experience in order to reduce residual variance and improve the precision of the estimates. We also included dummies to control for the order in which the videos are watched to avoid bias resulting from order effects. φ_c are case fixed effects. The variable of interest, $Open\ Disclosure_i$, is a dummy that equals one if

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Table 3. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Outcomes					
Further steps	420	0.37	0.48	0	1
Feelings of blame	420	0.27	0.45	0	1
Physician ratings	420	0.38	0.49	0	1
Communication skills	420	0.27	0.45	0	1
Incident severity	420	0.37	0.48	0	1
Student characteristics					
Male	140	0.37	0.48	0	1
Health	140	6.06	0.84	3	7
Med/physio student	140	0.46	0.50	0	1
Parent in health/law	140	0.31	0.46	0	1
Incident experience	140	0.31	0.46	0	1

Table 4. Results on tests of covariate balance

	Mean		
	Control group mean (1)	Treatment group mean (2)	OLS difference (3)
Demographic characteristics			
Male	0.39	0.35	−0.04 (0.663)
Health/law background			
Health	5.96	6.18	0.22 (0.126)
Med/physio student	0.47	0.44	−0.03 (0.715)
Parent in health/law	0.32	0.29	−0.03 (0.747)
Incident experience	0.29	0.32	0.03 (0.686)
N	72	68	140

Notes: The table reports the results based on tests of covariate balance. Columns (1) and (2) display means for the control and the treatment group, respectively. Column (3) reports the coefficients from an OLS regression with *open disclosure* as the explanatory variable, with corresponding p-values shown in (parentheses).

Table 5. Descriptive statistics outcomes

	Defensive communication (1)	Open communication (2)	Difference (2)-(1) (3)
(1) Further steps	0.32 (0.47)	0.42 (0.49)	0.10**
(2) Feelings of blame	0.20 (0.40)	0.35 (0.48)	0.15***
(3) Physician ratings	0.37 (0.48)	0.40 (0.49)	0.03
(4) Communication skills	0.23 (0.42)	0.31 (0.47)	0.08*
(5) Incident severity	0.35 (0.48)	0.39 (0.49)	0.04
N	216	204	

Notes: Cells contain means and (standard errors). ***p < 0.01, **p < 0.05, *p < 0.1.

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participant i has seen the videos with open disclosure. Hence, β measures the impact of open disclosure on feelings and behavioural intentions of participant i, all else being equal. Standard errors are clustered at the participant level in order to control for potential correlations between unobservable characteristics within individuals.

5.2 Main results

Table 6 provides the results obtained from estimating equation (1). The results show that being open results in a statistically significant higher intention for patients to engage in further (legal) steps and greater feelings of blame against the physician. More specifically, participants exposed to open disclosure are more than 10 per cent more likely to pursue the physician for the harm suffered and 16 per cent more likely to blame the physician. At the same time, open disclosure does not lead to different physician ratings or different perceptions of the severity of the incident. Interestingly, physician communication skills are rated almost 8 per cent higher than the defensive counterpart.

Results also show that men have significantly better perceptions of physicians' communication skills and participants with parents who have working experience in health or law express less feelings of blame against the physician.

5.3 Interacting effects of open disclosure

In this section, we examine the interaction of open disclosure with three participant characteristics: incident experience (previous experiences may create expectations and alter the treatment effect), medicine or physiotherapist students (who are educated about patient communication) and gender (women are especially sensitive to communication style). However, as Table 7 shows, none of these interaction effects are statistically significant.

5.4 Further results

In Table 8, we run separate OLS regressions for each dummy outcome instead of combined constructs. These results help us understand which behavioural intentions participants pursue following open disclosure, and which patients' feelings are influenced. Participants exposed to

Table 6. Main results

	(1)	(2)	(3)	(4)	(5)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.105* (0.058)	0.156*** (0.048)	0.024 (0.046)	0.078* (0.043)	0.021 (0.043)
Controls					
Male	0.084 (0.060)	0.074 (0.050)	0.039 (0.048)	0.116** (0.047)	0.014 (0.052)
Health	−0.009 (0.038)	0.010 (0.026)	0.045 (0.030)	0.040 (0.025)	0.030 (0.027)
Med/physio student	−0.053 (0.055)	−0.037 (0.048)	0.070 (0.047)	0.010 (0.045)	−0.073 (0.047)
Parent in health/law	−0.035 (0.064)	−0.119** (0.052)	−0.018 (0.051)	−0.037 (0.044)	0.044 (0.054)
Incident experience	0.018 (0.061)	−0.021 (0.049)	−0.050 (0.052)	−0.076 (0.046)	−0.027 (0.046)
N	420	420	420	420	420

Notes: The table reports OLS results. Heteroscedasticity robust standard errors in (parentheses) are clustered at the participant level. In each regression, we controlled for case and order fixed effects. ***p < 0.01, **p < 0.05, *p < 0.1.

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Table 7. Results with interaction terms

	Panel A: results with gender interaction term				
	(1)	(2)	(3)	(4)	(5)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure × male	−0.072 (0.118)	0.102 (0.098)	0.095 (0.097)	0.005 (0.102)	0.004 (0.100)
Open disclosure	0.131* (0.069)	0.119** (0.060)	−0.011 (0.057)	0.076 (0.050)	0.020 (0.051)
Male	0.119 (0.082)	0.025 (0.062)	−0.006 (0.062)	0.114* (0.060)	0.012 (0.080)
Controls	Yes	Yes	Yes	Yes	Yes
Case fe	Yes	Yes	Yes	Yes	Yes
Order fe	Yes	Yes	Yes	Yes	Yes
	Panel B: results with med/physio student interaction term				
	(6)	(7)	(8)	(9)	(10)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure × med/physio student	0.028 (0.109)	−0.092 (0.095)	0.034 (0.091)	0.035 (0.089)	0.009 (0.088)
Open disclosure	0.092 (0.084)	0.198*** (0.065)	0.008 (0.061)	0.062 (0.056)	0.017 (0.060)
Med/physio student	−0.066 (0.073)	0.008 (0.060)	0.053 (0.061)	−0.008 (0.055)	−0.078 (0.071)
Controls	Yes	Yes	Yes	Yes	Yes
Case fe	Yes	Yes	Yes	Yes	Yes
Order fe	Yes	Yes	Yes	Yes	Yes
	Panel C: results with incident experience interaction term				
	(11)	(12)	(13)	(14)	(15)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure × incident experience	0.070 (0.122)	−0.041 (0.092)	−0.022 (0.100)	−0.114 (0.090)	0.062 (0.087)
Open disclosure	0.083 (0.070)	0.169*** (0.062)	0.031 (0.056)	0.114** (0.055)	0.002 (0.054)
Incident experience	−0.016 (0.078)	−0.001 (0.061)	−0.040 (0.063)	−0.021 (0.055)	−0.057 (0.068)
Controls	Yes	Yes	Yes	Yes	Yes
Case fe	Yes	Yes	Yes	Yes	Yes
Order fe	Yes	Yes	Yes	Yes	Yes
N	420	420	420	420	420

Notes: The table reports OLS results. Heteroscedasticity robust standard errors (in parentheses) are clustered at the participant level. In each regression, we added controls and case and order fixed effects as in Table 6. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 8. Results on separate dummy outcomes

	Panel A: regression results separate dummy behavioural intentions				
	(1)	(2)	(3)	(4)	(5)
	Filing a lawsuit	Discussing options with lawyer	Complaining to the hospital	Contacting general practitioner	Changing physician
Open disclosure	0.061 (0.051)	0.155*** (0.059)	0.135** (0.058)	0.063 (0.058)	0.050 (0.051)
Controls	Yes	Yes	Yes	Yes	Yes
Case fe	Yes	Yes	Yes	Yes	Yes
Order fe	Yes	Yes	Yes	Yes	Yes
	Panel B: regression results separate dummy thoughts and feelings				
	(6)	(7)	(8)	(9)	(10)
	Trust in physician	General impression of physician	Physician competence	Physician sincerity	Physician empathy
Open disclosure	−0.050 (0.052)	0.089** (0.043)	−0.035 (0.038)	0.063 (0.050)	0.053 (0.043)
Controls	Yes	Yes	Yes	Yes	Yes
Case fe	Yes	Yes	Yes	Yes	Yes
Order fe	Yes	Yes	Yes	Yes	Yes
N	420	420	420	420	420

Notes: The table reports OLS results. Heteroscedasticity robust standard errors (in parentheses) are clustered at the participant level. In each regression, we added controls and case and order fixed effects as in Table 6. ***p < 0.01, **p < 0.05, *p < 0.1.

open disclosure are more than 15 per cent more likely to contact a lawyer to discuss their options regarding the medical incident and more than 13 per cent more inclined to complain to the hospital (panel A). Although the coefficients for other behavioural intentions such as filing a lawsuit, contacting general practitioner and changing physician are positive, they are not significant. Panel B indicates that open disclosure leads to a significantly better general impression of the physician, while no significant differences for the trust in physician, physician competence, sincerity and empathy are found.

5.5 Robustness checks

Table 9 shows the results of a series of robustness checks. Panel A shows the main results for the original Likert outcomes instead of dummy variables. These results are consistent with the results presented in Table 6; that is, a significant positive impact of open disclosure on intention to take further steps, feelings of blame against physician and physician communication skills, although there was no effect on physician ratings and incident severity.

To check the robustness of the cut-offs we used for the main analyses, we performed OLS regressions on dummies with cut-offs of one point lower and higher on a seven-point Likert scale in panels B and C, respectively. Compared with Table 6, the results are consistent, apart from the feelings of blame against physicians in panel B. A potential explanation is that the feelings of blame are rated relatively high (mean of 4.65 on a seven-point Likert scale), and a lower cut-off leads to less variation for the dummy variable.

To investigate the sensitivity of our results to decision time (i.e. the total time the respondent spent on the experiment), we dropped the slowest 25 per cent and the fastest 25 per cent of

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Table 9. Robustness checks

	Panel A: main results with Likert outcomes				
	(1)	(2)	(3)	(4)	(5)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.343** (0.143)	0.369** (0.161)	−0.005 (0.119)	0.262*** (0.098)	0.098 (0.131)
	Panel B: main results with 1-point lower cut-off for dummy outcomes				
	(6)	(7)	(8)	(9)	(10)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.125** (0.051)	0.072 (0.052)	0.015 (0.048)	0.077* (0.043)	−0.028 (0.041)
	Panel C: main results with 1-point higher cut-off for dummy outcomes				
	(11)	(12)	(13)	(14)	(15)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.083** (0.038)	0.065** (0.030)	0.000 (0.023)	0.044** (0.019)	0.044 (0.035)
	Panel D: main results without 25% slowest respondents				
	(16)	(17)	(18)	(19)	(20)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.100 (0.066)	0.123** (0.052)	0.041 (0.055)	0.107** (0.048)	0.034 (0.049)
	Panel E: main results without 25% fastest respondents				
	(21)	(22)	(23)	(24)	(25)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.095 (0.071)	0.176*** (0.059)	0.035 (0.055)	0.095* (0.049)	−0.015 (0.047)
	Panel F: main results with probit regressions (average marginal effects)				
	(26)	(27)	(28)	(29)	(30)
	Further steps	Feelings of blame	Physician ratings	Communication skills	Incident severity
Open disclosure	0.103* (0.055)	0.160*** (0.046)	0.025 (0.045)	0.081** (0.041)	0.017 (0.042)
N	420	420	420	420	420

Notes: The table reports OLS results (except for panel F, panel F shows average marginal effects of Probit regressions). Heteroscedasticity robust (delta-method in panel F) standard errors (in parentheses) are clustered at the participant level. In each regression, we added controls and case and order fixed effects as in Table 6. ***p < 0.01, **p < 0.05, *p < 0.1.

respondents of the sample, in panels D and E, respectively. These results are comparable to those of the whole sample, except for the non-significant coefficient of open disclosure on intentions to take further steps.

We also repeated our main analysis with probit regression models in panel F. The results in this panel are completely consistent with those of Table 6.

6. Discussion and limitations

This aim of the present study was to analyse the impact of physician's open disclosure in case of a possible medical neglect on how patients feel and behave. Our first result is that when physicians openly disclose a medical incident, patients are significantly more engaged to take initiatives such as contacting a lawyer to discuss options and complaining to the hospital, although patients are not more intended to file suit directly.

This finding is contrary to previous studies, which have suggested that open disclosure correlates negatively with the number of claims. A possible explanation for this result is the way we manipulated physicians' communication about the responsibility for the incident differently than related studies in the field. Particularly, in the open videos, the physician enumerated possible objective causes for the incident, leaving open the discussion of whether the physician made a mistake or not. This contrasts to the defensive counterpart, in which the physician says that the patient's medical condition or behaviour caused the incident. In most studies, physicians' responsibility (and not patients' responsibility) is clear in both the open and defensive communication videos. As proving physicians' responsibility is a decisive factor for getting indemnified, we expect that this manipulation leads participants in the treatment group (where responsibility for the incident is unclear) to report significantly greater feelings of blame against the physicians and be more convinced that they are entitled to receive an indemnification and that further steps are worth the effort than participants in the control group (where responsibility for the incident is attributed to the patient's situation).

This finding raises intriguing questions regarding the specific elements of open disclosure driving patient behaviour. Examining these elements (e.g. showing responsibility, offering compensation, saying sorry) separately is an important issue for future research. In addition, more insights are needed into the impact of open disclosure in the further steps of the unfolding of a medical incident (i.e. not only focussing on the first step in the open disclosure process like in our research). Seeking answers to questions such as 'could open disclosure eventually lead to more indemnity payments?' would be important for assessing the general impact of open disclosure and finding solutions for the legal battlefield between physicians and various stakeholders involved, such as insurance companies.

At the same time, our results follow existing literature in that open disclosure leads to a better general impression of a physician and his communication skills. We also found that open disclosure does not impact patients' trust in a physician and his or her competence, the perceived incident severity and intentions to change physician. Showing physicians that physician ratings by patients are not affected by open disclosure might be an important first step in boosting open communication, given that physicians have mentioned potential reputational damage as a major issue in the unfolding of a medical incident (Vandersteegen *et al.*, 2015), and is therefore considered a main driver of physicians' defensive communication in practice.

There are several reasons why it is important to find explanations and resolutions for physicians' fear for malpractice procedures. First, besides defensive communication, physicians' medical liability risk may drive physicians to perform more tests and procedures than is strictly medically necessary, or to what is known in the literature as defensive medicine (OTA, 1994; Kessler and McClellan, 1996; Klingman *et al.*, 1996; Garattini and Padula, 2020). Multiple studies have examined various drivers of physician's defensive medicine in an attempt to approach efficient spending of limited health care budgets (Bradford, 1995; Kessler *et al.*, 2005; Roberts and

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Hoch, 2007; Sloan and Shadle, 2009; Shurtz, 2013; Amaral-Garcia *et al.*, 2015; Avraham and Schanzenbach, 2015; Osti and Steyrer, 2017). However, more attention needs to be given to the interplay with incident disclosure, and how this may create a vicious cycle.

Second, defensive communication about medical incidents may enlarge the suffering of physicians as second victims, as being open towards colleagues, family, friends, patients and their relatives may be a strategy for physicians to restore trust and self-confidence (Hannawa *et al.*, 2013; Seys *et al.*, 2013; Ullström *et al.*, 2014; Coughlan *et al.*, 2017). At least as importantly, in the absence of open disclosure, there will be no learning opportunities for institutions and physicians to improve their processes and avoid future recurrences (Wu and Steckelberg, 2012; Seys *et al.*, 2013).

Third, medical incidents and their unfolding are associated with large financial and emotional costs (Carey and Stefos, 2011; Bielen *et al.*, 2020, 2019), and increasing health care costs are a concern in developed countries (OECD, 2015). With the establishment of the Funds for Medical Incidents in 2012, Belgium introduced no-fault liability in its malpractice system to tackle compensation issues and lower the number of complex malpractice procedures. However, the system suffers from backlogs and a lack of experts, and thus currently lacks efficiency and effectivity in practice (FMO, 2020), which may have increased uncertainty among physicians about their true malpractice risk. Therefore, optimising malpractice laws and reducing related physician defensive behaviour should be a primary focus of policy makers.

The present study has certain limitations. First, the study only addresses intentions, instead of real patient behaviour. Therefore, additional research is necessary in order to examine whether intentions also match real behaviour for the research question discussed in this paper. Second, these findings cannot be extrapolated to all patients. After all, only students participated, and the health and law context of Belgium is quite different from other countries.

7. Conclusion

This study is the first to use VR techniques in combination with an experimental design to examine the impact of physician verbal open incident disclosure on patients' feelings and behavioural intentions. More specifically, we shot 360° videos of hypothetical physician–patient conversations after the occurrence of a medical incident. For each of the three cases, two versions are made: one where the physician openly communicates verbally about the incident and a defensive counterpart. It is important to note that everything else is kept constant, such as physician non-verbal behaviour and patient symptoms, ensuring that physicians' verbal communication is driving the effect. With our design and the use of VR techniques, we overcome the omitted variable bias and external validity problems that are common in existing literature in this domain.

One hundred and forty economics, medicine and physiotherapy students each randomly evaluated three videos with the same communication style (open vs. defensive). The results show that open disclosure results in higher intentions to take further (legal) steps, but does not directly damage a physician's reputation. We found that participants in the open videos are more likely to blame the physician, while we found no difference in physician ratings and the perceived incident severity between the groups. Participants' general impression of how the physician handles the incident and his communication skills are better than in the defensive counterpart.

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Ethical standards. This study was approved by the Medical Ethical Committee of Hasselt University (REC/SMEC/VRAI/190/120) and therefore meets all the requirements.

Informed consent. Informed consent was obtained from all individual participants included in the study.

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