



Structure of Medical Explanation: A Pragmatic Model

Francois Auclair^{1*}, Michael Orsini², Sophia Muller³, Nancy Laffin RN⁴

Abstract

There is a body of evidence revealing that poor outcomes, complaints and malpractice litigation are due, in part, to poor communication and absence of satisfactory explanation. We view explanation as a linguistic structure that should promote understanding but there is no agreement on what such a structure should be. We propose a model of explanation derived from empirical evidence. We constructed our model by thematically analyzing the explanations provided by 21 senior residents in medicine. Using a standardized case of endocarditis, we asked the residents to explain the problem as if they were addressing a patient. We recorded and transcribed their explanations, systematically identifying and analyzing themes and patterns. Our analysis focused on how the residents used evidence, articulated reasons and causes, employed deduction and inference, and made analogies and generalizations. We then analysed how the residents performed the explanation by examining the nature and organization of the sentences uttered. We propose a model of explanation based on the relations between two types of representations: a theoretical representation of the pathophysiological model and an empirical representation of the state of the patient. Causal relations are expressed in both types of representations. The theoretical representation targets the empirical representation. This model is inspired by works in philosophy of science and philosophy of language. The model could be used as a theoretical framework in the medical curriculum to initiate reflection on how to explain to patients.

Keywords: Explanation; Explaining; Communication; Model; Theory; Curriculum; Litigation; Philosophy

Introduction

The problem

The purpose of explanation in medicine is to answer why things happen in the context of caring for patients and to encourage communication among members of the community of physicians, nurses, and patients. We view the explanation as a linguistic structure that promotes understanding. Unfortunately, there is no agreement on informal criteria or on a model of explanation for patients in medicine. Poor communication is a major source of complaints and malpractice litigation, and there is evidence that lack of proper explanations given to patients is a significant problem. In a series of 227 cases of legal action, when explanations were given to patients, the overall view was that they were satisfactory in only 17.7% of cases [1]. Similarly, a survey of patients discharged from hospital reveals that only few were able to state their diagnosis [2] and only 37% were able to recount the purpose of all their medications [3]. Little is known about whether there is a relation between a patient's understanding and the structure of the explanation itself. One reason

Affiliation:

¹Division of Infectious Diseases, The Ottawa Hospital, Ottawa, ON Canada

²Faculty of Social Sciences and Political Studies, University of Ottawa, Ottawa, ON Canada

³Nomos Consulting and University of Ottawa, ON Canada

⁴The Ottawa Hospital, Ottawa, ON Canada

*Corresponding Author

Francois Auclair, Division of Infectious Diseases, The Ottawa Hospital, Ottawa, ON Canada

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postulated is the relative absence of a theoretical framework that would make a clear interpretation possible [4]. There is conflicting evidence on the desirable length or the number of explanatory statements explanation [5-9]. The format or media of explanation seems to be important: oral information in person or over the phone is better understood than written material [9]. Similarly, a review of trials involving the use of multimedia or enhanced consent forms has shown that the only effective method to improve the understanding of consent is to have a one-on-one extended discussion between staff and research participant [10].

Importantly, the context in which medical explanations are provided has changed dramatically in the last several decades with the widespread proliferation of misinformation and disinformation now available at our fingertips. Patients now have several options, some of them deeply unreliable or even dangerous, to seek alternative explanation if they are not pleased with the one provided by their physician. With the COVID-19 pandemic, we have seen the emergence of misinformation and conspiracy theory about health and vaccines in particular resulting in vaccine hesitancy [11]. Science based explanations in everyday language refuting misunderstanding with mechanisms of action have been shown to best reduce vaccine hesitancy [12]. There is, however, a general decline of trust in expertise [13].

Philosophical views on the nature of explanation

What constitutes an explanation has been the subject of inquiry at least since Aristotle, who postulated that identifying causes was necessary to explain why something is the case [14]. In the 20th century, in philosophy of science, logical empiricists thought of explanation in logical terms. Hempel's theory of explanation [15] states that what is being explained follows deductively from the combination of laws and empirical conditions: in a classic example it describes the explanation of the length of the shadow of a pole as a result of the laws of light propagation and empirical conditions as the length of the pole and angle of the sun. Salmon developed a causal theory of explanation in which causal mechanisms are identified. "What counts as acceptable scientific explanation depends crucially on the causal and temporal structure of the world and these are matters of fact rather matters of logic" [16] p254. What qualifies as explanations is that they point to causal chains [17]. More recently, van Fraassen developed a pragmatic model of explanation as an answer to a why question and in which the answer takes the form as making clear the relationship between a theory, the facts and the context [18] p156. The explanation of why something is the case typically consists of exhibiting the important (salient) factors in the part of the causal net [18] p124. For example, the explanation of this patient's respiratory failure (fact) is a severe inflammatory response to an infection by a specific virus (COVID 19) (theory) acquired after contact with a coughing person during an epidemic (context). The context

is important as it determines relevance and contrasts the case from possible alternative explanations. A fundamental aspect of the nature of explanation is that it is a communicative action. Explaining is what JL Austin calls an illocutionary act like warning or promising [19]. Achinstein developed a theory of explanation that focused on the act of explaining something to someone. For Achinstein, a person explaining is uttering words in a certain context with appropriate intentions of rendering the question understandable. It does so by producing the knowledge expressed by the answer. One understands the question if one is in "in a complete knowledge-state with respect to the direct question" [20] p57. The explanation is context dependent. To make something understandable is pragmatic in that it depends on a set of conditions such as the interests and background knowledge of who is seeking to understand and can thus vary widely between any literate persons [20] p113.

Methods

Subjects and setting

We presented a standardized written case of endocarditis to 21 senior residents in Internal Medicine at the Ottawa Hospital in Canada in January 2011. The case was written as a typical presentation of endocarditis in a patient with fever, history of mitral valve surgery, multiple positive blood cultures and embolic phenomenon. We provided the residents with sufficient time to read and think until ready to explain the case. Thereafter, we asked the residents to explain the diagnosis as if they were in presence of a real patient. We recorded and transcribed each of the residents' respective explanation.

Analysis

We utilized a thematic analysis to examine the patterns and approaches to residents' explanations, whereby themes and patterns were sought from empirical evidence [21]. Five recordings were first analysed in discussion between all investigators. This analysis of transcriptions generated several key points that were retained as important concepts.

Appendix

Concepts initially retained. We (FA and SM) then applied these concepts to identify patterns of reasoning expressed in the residents' explanations. We analyzed the transcriptions to examine how evidence was utilized, whether reasons or causes were provided, and the extent to which deduction, inference, analogy, or generalizations were employed. Additionally, we assessed the inclusion of descriptions of mechanisms and the presence of repetitions within the explanations. We then analysed how the residents performed the explanation by examining the nature and organization of the sentences uttered. This allowed us to construct the model of explanation based on how language was used.

For the purposes of this study, we obtained written informed consents from all participants, and the Ottawa Research Ethics Boards reviewed and approved the project.

Results

Patterns of reasoning with quotes from recordings (Rec) (n residents who used the type of pattern)

Evidence leading to deduction/inference (15)

(Rec 2: “test we do to see if bacteria in blood were positive... this means you have an infection in your blood... that needs to be treated”)

Evidence leading to diagnosis followed by relation to new evidence (7)

(Rec 6: “This altogether with the blood culture that is positive... it is likely that you have a condition so called endocarditis...the toe can be explained by this condition”)

Evidence leading to another evidence (5)

(Rec 5: “your kidneys aren’t working completely... and you have a little bit of, hum, blood in your urine... and those two things are a little bit concerning”)

Generalization on endocarditis (5)

(Rec 14: “these two things together are concerning for what we call endocarditis. Endocarditis is basically, a group of bacteria that are in the blood that then attach to your valve”)

Generalization on endocarditis leading to evidence (4)

(Rec 13: “when we have patients with this problem, we are concerned about... presentations of what is called endocarditis... the valve on the heart is infected... can cause... a release of small emboli or blood clots to other areas of the body”)

Mechanism explaining a risk for endocarditis (8)

(Rec 20: “because you have blood cultures, blood uh bacteria in your bloodstream and the fact that you’ve had a previous procedure done on your mitral valve, you’re at a much higher risk than an average person for developing an infection of the mitral valve...”)

Language structures used during explanations

We found that the explanations were constructed around three types of propositions:

- representation of the theoretical model of what is currently known about the disease
- representation of the empirical state of the patient
- relations between the theoretical model and the empirical state

Representation of the theoretical model of what is currently known about the disease including causal relationships

Rec 4: The heart acts as a pump and pumps blood to the rest of the body ... if there is an infection... on the heart valve this could potentially be... causing a showering of the ... infection throughout the body (causal relation)

Rec 9: A condition called endocarditis... because of the previous mitral valve repair that bacteria has been able to find a home on one of the valves in your heart. (causal relation revealing a mechanism)

Rec 12: “you’ve had hum, mitral valve repair in the past hum, and that puts you at risk of having possibly an infection on the valve. So, the next step will be to do an echocardiogram which is an ultrasound of the heart... to see whether there is in fact an infection there”

Rec 14: endocarditis is basically... a group of bacteria that are in the blood and that then attach to your valve... because you had a valve repair it makes you more prone to having this happen. (causal relation revealing a mechanism)

Rec 17: You have is something called endocarditis which means that ... on your mitral valve there is likely a source of infection... because you had this repaired in the past you’re at a higher risk than the average person of getting this (causal relation revealing a mechanism)

Rec 19: endocarditis is... infection of the heart valves, due to bacteria present in the blood which then colonizes the heart valves causing... infection... which can erode and damage .. heart valves ... but also a variety of other symptoms” (causal relation revealing a mechanism)

Representation of the empirical state of the patient including causal relationships

Rec 1: “the sound we hear in you hear... with the positive blood cultures... concerning that there may be an infection”

Rec 3: “you are probably worried... your big toe... because the bug in your blood, it can bring some more complications... like a little clot that block the vessels in the extremities”

Rec 7: “We did some tests ... including blood cultures and those tests came back positive...it means ... is likely the cause for your fever and your chills”

Rec 10: growth of bacteria... flung off into the blood and can cause kind of clots in the blood flow and that’s probably what’s causing that purple lesion on your right toe

Rec 20: “based on your examination there is some evidence to suggest that the valve might be infected and it is currently leaking”

Rec 21: “we do see some red cells, too many red blood cells in your urine, more than what we would expect... which shows us that your kidneys are being impacted”

Explanations based on relations between the theoretical model and the empirical state

Rec 2: “Given the fact that you have had this heart surgery in the past we would be worried about something called endocarditis... an infection of the valve in your heart” (empirical related to theoretical)

Rec 4: “fever and chills and lower back pain... you have a history of heart valve repair... and bacteria in the blood... concerning (for) an infection on the heart valve condition known as bacterial endocarditis” (empirical related to theoretical)

Rec 5: “... your kidney function is abnormal... One of the things endocarditis can do is sometimes little bits of the infection... on your heart valve can break off and... go to different part of your body... for example to your kidneys” (theoretical related to empirical)

Rec 6: “this altogether with the blood culture that is positive... it is likely that you have a condition that is so called endocarditis or inflammation or infection in the, heart valve. ... the toe that is also ... that is painful... can be explained by this condition as well.” (empirical related to theoretical)

Rec 8: “the other ah, main reason for why we need to look at the heart is because of that hum, mark that we found on your right big toe...that can be indicative of the fact that a little piece of bacteria may have broken off of the heart valve and... ended up in the toe” (theoretical related to empirical)

Rec 11: “when I listen to your heart you have a murmur hum that wasn’t heard before ... but this murmur that you now have seems to suggest that bacteria have ah seeded onto that valve and are hum causing infections in other parts of the body” (empirical related to theoretical)

Rec 13: “the blood work that ah, we drew shows there is bacteria in the bloodstream... When we have patients with this problem we are concerned about multiple hum, presentations of what is called endocarditis (empirical related to theoretical) and that is a fancy word for saying that the valve on the heart is infected with a bacteria and may have a mass which is essentially going to ah, cause problems.

One of the problems that this mass can cause is, ah, a release of small emboli or blood clots to other areas of the body. You have shown me a, or I’ve seen a spot on your lower leg here that may indicate a clot has travelled from your heart to the extremities or your leg.” (empirical related to theoretical)

Rec 15: “you had a repair of your mitral valve... that sort

of predisposes you to be infected... we are concerned that there is an infection of the valve that’s been repaired in the past ah, and once that infected ah, you can get the symptoms like the ones you’re having.” (theoretical related to empirical)

Rec 16: “we’ll also be doing ah, you know an MRI of your spine because you have been having some back pain and, ah it’s not uncommon for people to have infection of their spine after they...had a blood infection.” (theoretical related to empirical)

Rec 18: “when that happens you know the bacteria in the blood sometimes can... set up shop in different parts of the body and, in someone like yourself who’s had problem with heart in the past in term of their heart valves, they might be at higher risk of uh... having the bacteria ah, settle down on the heart valve” (empirical related to theoretical)

Discussion

The structure of the explanation as described by these narratives is a combination of two intertwined sets of propositions representing the theoretical model on one hand and the empirical state on the other. This is in line with Karadimas’ explanation as a relation between representations [22]. In both representations, causal relations or chains are given. The representation of the empirical state of the patient is illuminated by the representation of the theoretical model of the disease. It does so by bringing knowledge to the patient thus allowing understanding as noted by Achinstein. For example, in narrative 13, it is said that (on the empirical state) bacteria are seen in the blood and that this raises the concern for what is called endocarditis (a theoretical model of heart valve infection) and that in this model clots can form on the valve and can embolize as a cause of the leg lesions. This explanation brings knowledge for the patient to understand what the cause of skin lesion is by making explicit causal links in the theoretical model as well as in the empirical findings. The same type of structure can be seen to various degrees in all the narratives describing relations between the theoretical model of endocarditis and the empirical state of the patient. What the residents did in this experiment was to perform verbally the actual explanation: they were answering the question “what is going on with me?” and in answering they were performing the act of explaining as described by Austin. That is different from simply talking about the disease; they were providing new knowledge to the patient with the intention of clarifying what was going on so that they understood. According to Habermas’ Theory of Communicative Action; in a speech act such as explaining, a person performs a discourse with claims to truth, rightness, and sincerity to reach understanding [23] p17.

As emphasized by van Fraassen, explanation is also context dependent. This is well illustrated in narrative 15 by the fact in their explanation; residents frequently stated the

fact that the patient's problem occurred after valve surgery, indicating a risk factor as part of the explanation: "you had a repair of your mitral valve...that sort of predisposes you to be infected..." It is notable that we had included in the case history the fact that the problem occurred after travelling to southern islands for vacation. No resident mentioned that fact indicating that this was rightly considered irrelevant in this context while it is often relevant in other infectious diseases. Other important contexts in situations like this case would include use of IV drugs or presence of pacemaker for example.

Our model is quite limited in scope, however. If we make a distinction between disease and illness, the model is limited to the current biomedical theory and clinical manifestations. Illness represents personal and cultural reactions to disease. It is strongly influenced by cultures and even if a patient can see the relations elicited in the model, they may not accept the explanation. Disease is assumed to be more basic, and cure is the purpose of medicine. Much of the critique of medical care is directed at the inattention of illness. Such inattention to illness can be responsible for poor patient compliance [24]. Patients often have an explanation of their own based on their beliefs and culture, and that may conflict with the physician's explanation. For example, Setchell has shown that patients' own explanation of low back pain may conflict with "best practice guidelines" and result in avoidance of physical activity [25]. In such circumstances, a clinician must mediate between different cognitive orientation, beliefs, and explanations.

This model is also severely limited by the fact that the case presented was on paper and thus did not allow for real intersubjective communication. There was no possibility of discourse where the patient could challenge the truth or understanding of the explanation. The format assumed that the explanation given by the resident was comprehensible for the patient. There was no measure of other important context elements such as the level of language or the level of interest of the patient. There was also no measure if it increased understanding; this will require empirical testing with real patients. Finally, another limitation is that our model is exemplified with only one disease; endocarditis. We cannot make a generalization that such a model could provide a suitable explanation structure in other conditions. We nevertheless believe that this model of explanation is worth examining because there is a lack of theoretical or practical explanation for patients being taught in medical school [26].

Conclusion

Teaching explanation in medical education is very limited while the demands of clinical practice require its use for every patient. It has been recommended that explanation be integrated in medical curriculum [26]. We presented

a model of explanation based on relations between the theoretical model of disease and the empirical state that needs to be explained. The explanation is a critical moment in a collaborative decision-making process where the physician provides expert knowledge to the patient for an adequate understanding to arrive at an informed decision. The field of narrative medicine begins from the premise that stories are at the core of communication between physicians and patients. Narrative competence is "the ability to acknowledge, absorb, interpret, and act on the stories and plights of others" [27]. Providing a valid explanation is central to developing narrative competence, and to becoming a more effective physician.

Declarations

Ethics approval and consent to participate

Ethics approval Consent to Participate was obtained in accordance with the Declaration of Helsinki.

The research was approved by The Ottawa Hospital Research Ethics Boards.

Consent for publication

All authors consent to the publication of this manuscript

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Authors contribution

CRedit

Francois Auclair: concept and methodology, writing and review, resources, supervision, administration, funding acquisition.

Michael Orsini: methodology, writing and review

Sophia Muller: methodology, investigation, review

Nancy Laffin: project administration, data curation, resources, data safety, consent acquisition

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