Beyond Hope and Fear

An investigation into public perception on AI in healthcare using an ethnographic film

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Abstract

Introduction: In the past year, Artificial Intelligence (AI) has become a headline topic across the world. This was the culmination of years and years of development. This has also been the case in healthcare, where AI tools have shown promising results in diagnosis as well as a lot of potential in personalised medicine. For AI in healthcare to be successful, it must have the public's backing, and with the current interest there is little margin for error. This thesis studies the public opinion on AI in healthcare using an accessible medium, film.

Methods: An ethnographic film displaying the daily workings of the pathology department at the Radboudumc was shown to focus groups. The film was shown to three different audiences, the first consisting of pathologists, the second of academics and students, and the third of patients. Following the watching of the film, a semi-structured conversation was held during which the participants commented on the footage, the use of AI in healthcare and the film as an information tool. The conversations were recorded, transcribed and coded into a code tree to identify the most prevalent themes.

Results: The pathologists mainly commented on the film itself, which they believe is accurate and portrays a realistic image of pathology, although it shows only a snippet. The academics expressed the most concerns, describing the difficulty of using a black box in a clinical setting, the risk of fading lines between health and illness, and a worry for a loss of jobs. The patients were positive about the use of AI in healthcare, as they believed it can benefit both the patients and the healthcare workers. They did emphasise that AI cannot replace humans. All groups thought that the film was a little difficult to understand and that it mixed up AI and automation.

Discussion: The film served as a great starting point for conversation in all groups. Most notable was the call from most participants to make a distinction between AI and automation. This shows that non-developers have a tendency to judge AI by its intelligence, rather than by how it works, and it is a clear example of the human predisposition to categorise. However, it mainly shows that AI is an incredibly complex concept that is hard to grasp for many people. Especially the patients did not find this particularly concerning, they mainly want the doctor to be able to explain a diagnosis, even if it is made by an AI tool. This ties in with a key concern regarding the future of healthcare, as the non-pathologists had emphasised the importance of human interaction.

Conclusion: This study adds to the existing literature on public opinion on AI in healthcare but sets itself apart by providing a realistic example of AI implementation in pathology. AI remains very difficult to understand for the general public, and more should be done to help them understand what it is and how it works. While film is an excellent medium to explain it, an ethnographic film is not the most suitable type for this purpose.

Lay summary

Artificial Intelligence (AI) has gotten a lot of attention in the past year. It has been said to be able to change our lives, for example by revolutionising healthcare. It has shown promising signs, especially in diagnosis. To present this and the invisible side of pathology to a broad audience, a film was created at the pathology department of the Radboudumc in Nijmegen, the Netherlands. In this laboratory, they have started using AI and are making plans to implement it in a variety of tasks in the next ten years. The film was shown to three different audiences, one consisting of pathologists, one consisting of academics and students, and the last consisting of patients. After watching the film, they discussed the film, the image it portrays of pathology and what they think of the use of AI in healthcare. The pathologists thought it gave a good impression of pathology, although it did not include all aspects. They were worried whether the film could be too complicated. The academics were quite worried about the use of AI, as they saw a loss of jobs and a future without any human healthcare professionals. The patients spoke very positively of AI in healthcare. While they did think that safety and transparency are important, they felt a need for the implementation of AI in healthcare, due to the aging population and staff shortages. It was clear from the conversations that AI is difficult to understand. Most participants judged it on its perceived intelligence, rather than the actual technology. This shows a need for further education, as a basic understanding of what AI is and how it works is necessary for it to gain trust. While there was not a considerable lack of trust, it is important for people to know what AI will do, rather than incorrectly guessing. Film is a great medium to do this, and all participants commented that the film used in the study can do just that, provided it comes with more background information and explanations.

List of abbreviations:

AI	Artificial Intelligence
DL	Deep learning
DNN	Deep neural networks
EU	European Union
FDA	Food & Drug Administration
ML	Machine learning
NLP	Natural language processing

Introduction

In the eyes of the public, the field of Artificial Intelligence (AI) is booming, especially since the launch of the natural language processing (NLP) program ChatGPT in late 2022. It was one of the most convincing showings of what AI is able to do at this time. Various AI programs have grabbed headlines in the news since, such as *Can We No Longer Believe Anything We See?* in The New York Times (Hsu & Myers, 2023), and *AI poses 'risk of extinction' on par with nukes, tech leaders say* in The Washington Post (Gregg et al., 2023) to name some that are particularly worrisome. As of June 8th, the NY Times has published 322 articles on AI since the start of the year, with it currently being a spotlighted section on their website ('Artificial Intelligence', 2023). In the entire previous year, only 117 articles were published on AI, with nearly half coming in the last three months of 2022. It thus appears to be a very new and trending topic, leaving many people to believe that AI did indeed arrive out of the blue. This supposed abrupt introduction into our lives has caused people to be either very enthused, or quite concerned. Two doctors, who find themselves in the latter group, discussed this in a podcast, commenting that "AI is the scariest thing on the planet" and "it just suddenly arrived" (Varshavski, 2023). However, AI has been a part of our lives for longer than many are aware, for example by giving us personalised recommendations on Netflix. In the shadow of these mainstream developments, AI has also made huge strides in other fields, amongst which notably in medicine. As of October 2022, the U.S. Food & Drug Administration (FDA) has approved the use of 521 Artificial Intelligence and Machine Learning (AI/ML)-Enabled Medical Devices (Center for Devices and Radiological Health, 2022). Many of these devices are used in radiology, an area of healthcare that is embracing the use of AI due to its image-based and data-driven nature (Laï et al., 2020; Wang et al., 2017). While similar technologies are also being developed and tested in Europe, the implementation is slower due to stricter privacy laws in the European Union (EU). The use of AI in healthcare is a delicate topic and it is especially important that any implementation is done in an ethically mindful way. Failure to do so may lead to social rejection or distorted regulation and policies which could significantly hurt any future progress and acceptance (Morley et al., 2020). It is thus important to regularly study public opinion on AI in healthcare, as this provides an indication as to whether the field is moving in the right direction. AI is however very complex, and people tend to have limited knowledge on what AI in healthcare may look like (Beets et al., 2023; Young et al., 2021). One way to counter this problem, is to provide information through an accessible medium, such as film. This thesis will do just that, as it tries to answer the question 'What is the public opinion of various stakeholders on the use of Artificial Intelligence in healthcare after watching an ethnographic film on AI use in a pathology department?'. The question is divided in two parts, the first one being what the public opinion on

AI in healthcare of three different audiences is, and the second whether the film helps to inform people on what AI implementation in healthcare may look like.

AI itself is already a complex field, which combines a large variety of insights from a host of disciplines. This becomes increasingly the case when applications are being developed with a particular goal in mind, such as generating texts, or recognising tumours. Studying the public opinion on AI adds a whole new array of dimensions, with a need for expertise in ethics and societal issues, among others. Properly implementing AI-based technologies in our society, and especially in our healthcare system, is thus an incredible challenge, as so many stakeholders are involved and want to have a say in it. Such challenges are sometimes referred to as 'wicked problems' due to their unprecedented complexity and scope. Challenges of such scope require people who look at and understand the bigger picture, because 'when working on complex problems, especially on a global scope, a large variety of interrelated factors matter for understanding and solving problems' (Angerer et al., 2021). An interdisciplinary approach was thus adopted in the creation and execution of this study, following the model by Repko & Szostak (2021). While this thesis will not be able to cover all factors that play a role, it is important to have the awareness that a wide scope must be used when studying a phenomenon as complicated as the public opinion on the use of AI in healthcare. In this study, that will be done using film as a medium to give a realistic depiction of the use of AI in a pathology department in the Netherlands. The film was shown to three audiences, each with a different background, as this allows us to compare and contrast the viewpoints of these different groups when you present them with the same information.

What is Artificial Intelligence?

In order to study AI, it is important to define it. AI is not one specific kind of technology, but comes in multiple shapes and sizes, with a diverse set of possibilities. In broad terms, AI technologies can be divided in two major categories, those being machine learning and natural language processing (Jiang et al., 2017), but reality is a little more complicated than that. The machine learning (ML) techniques, which use statistics to fit models to data and allow for 'learning' by training these models with more data (Davenport & Kalakota, 2019). ML is one of the most prevalent forms of AI, as it has many uses. It is at the core of many current technologies and can be easily modified to fit a certain purpose. In healthcare, the most frequent use of ML is in precision or personalized medicine, where it is used to predict the best form of treatment given the specific circumstances of a patient. More complex forms of ML are neural networks, and deep learning (DL, also referred to as deep neural networks; DNN) (Davenport & Kalakota, 2019). These types of models consist of many layers of variables or features, weighing inputs and outputs to make predictions. The large numbers of variables that are weighed in these calculations allow for great accuracy, which is especially useful in medical applications involving oncology-oriented image analysis (Davenport & Kalakota, 2019). These AI technologies with complex layers of neural networks are often referred to as 'black boxes', due to the fact that it is near impossible for humans to understand how the models make their predictions. The second major category is that of natural language processing (NLP). As mentioned, the infamous ChatGPT is a good example of an application using this kind of technology. This category involves applications surrounding various aspects of language such as text analysis, translation and speech recognition (Davenport & Kalakota, 2019). These kinds of technologies require a large body of text to learn from and are often accompanied by ML technologies for analysis. The line between the two technologies is thus in reality fairly blurred. The main difference between ML and NLP is that ML techniques are well suited for analysing structured data, as one would encounter with numbers, whereas NLP techniques excel at extracting information from unstructured data, as one would find with texts (Jiang et al., 2017).

AI is thus more of an umbrella term for various algorithms that are able to learn and self-correct, allowing for constant improving of their accuracy (Jiang et al., 2017). One could say that AI is both a goal and a technology, as developers aim to create algorithms that could be considered intelligent. It has been described as "a growing resource of interactive, autonomous, and often self-learning agency (in the machine learning sense), that can deal with tasks that would otherwise require human intelligence and intervention to be performed successfully" (Floridi & Cowls, 2019). Other literature goes a step beyond this, claiming that AI "aims to mimic human cognitive functions with computer algorithms" (Gao et al., 2020). While the difference is rather subtle, it goes to show that even those working with AI do not agree on what the goal of AI actually is. Table 1 summarises some general uses of AI in everyday life and some specific uses of AI in healthcare.

Table 1: examples of general uses of AI and uses in healthcare

General uses	Uses in healthcare
Personalised content on video streaming services or social media	Determining the aggressiveness of a tumour
Generating human-like text responses based on a question or prompt	Checking images for possible lung embolisms
Virtual assistants, such as Siri, Alexa, and Google assistant	Determining whether a malignancy is present in the liver
Perceiving the environment and making safe decisions in autonomous vehicles	Deciding whether a patient with possible breast cancer has to get additional care after an MRI scan

What is medical AI?

In the field of healthcare, promising results have been published using AI systems, especially in diagnosis. While headlines on AI in general may seem pessimistic at times, it is the positive discoveries using AI in healthcare that tend to be covered extensively. For example, on the 25th of May, BBC news published an article with the headline *New superbug-killing antibiotic discovered using AI* (Gallagher, 2023). This air of positivity is also present in scientific literature, despite the many challenges that do still exist. These consist for a large part of regulation as well as integration into existing healthcare structures (Davenport & Kalakota, 2019). In some specific domains, such as radiology and pathology, promising AI systems are already being developed, tested and even used to some extent. One of these has been found to outperform radiologists on screening mammography when it comes to predicting breast cancer (McKinney et al., 2020). Another AI diagnostic tool was as accurate as a pathologist in recognising pancreatic cancer and was able to distinguish it from chronic pancreatitis, which is a challenging distinction to make (Cazacu et al., 2019). It is due to the data-driven nature of both AI and these two fields that AI-enhanced diagnostic tools are at the current most prevalent use of AI in healthcare. However, this is not where AI is expected to make the biggest impact. The bigger potential of AI in healthcare is in the realm of personalised medicine. In order to provide precision medicine for patients, a tremendous amount of data is required. As mentioned, this is what AI and in particular ML programs excel at dealing with. However, these uses of AI are at this point far-fetched due to various ethical challenges, including the distribution of finite resources, data privacy, and algorithm discrimination (Peng et al., 2021).

Another reason for the positivity is the feeling that there is a need for AI in healthcare. Many healthcare systems worldwide are under immense pressure, largely due to current and expected shortages in staff (WHO, 2022). With the large amount of health data that can be gathered nowadays, it is becoming too much to analyse for humans alone (Topol, 2019). In order to maintain a high level of healthcare, an increase in use of machines and the implementation of AI may be a necessity rather than a choice. Still, despite all the promises that AI brings and the possible need for it, the field may not be as advanced as it may seem. Some algorithms may outperform radiologists and pathologists in a single diagnosis, but their job is a lot more than only diagnosing pneumonias (Topol, 2019).

Public opinion on AI

With the growing public interest in AI, the public opinion on AI has become a trending topic in research. With the fast development rate of AI, the public perception seems to have become volatile, which makes studying this complicated. A long-term study from 2017 found that while public interest in AI has increased staggering amounts in the previous 30 years, the levels of pessimism and optimism have remained fairly similar (Fast & Horvitz, 2017). In the New York Times, optimistic articles have been written about two to three times more often than pessimistic articles, and that has remained true after a large explosion of interest in 2009 (Fast & Horvitz, 2017). However, in a recent study at Monmouth University, only 9% of respondents in the United States reported thinking that AI will do more good than harm (Murray, 2023). This is an interesting development, as a study from 2020 places the United States among the countries who are more trusting of AI, when compared with the EU (B. Zhang & Dafoe, 2020). One possible reason for the disparity in results is that before the introduction of ChatGPT, people used to think that AI is some futuristic entity, rather than something that they were already interacting with every day (B. Zhang, 2021). In addition to this, people are often asked about AI without it being placed in a clear context, such as what the AI system would do and where it would do this. As a result, people may define AI in different ways, which means that it may be unclear what is actually being studied. In order to remove these errors and to properly study public opinion on AI, one should provide specific examples of applications of AI rather than the general concept (B. Zhang, 2021). This is an issue that persists when studying the public opinion of AI in healthcare too. Participants often have only minimal knowledge of how AI works (Fritsch et al., 2022). This is something that even medical professionals and students struggle with, despite the fact that they are likely to use it in their professional life (Pinto Dos Santos et al., 2019; Yang et al., 2022). Young et al. (2021) found for example, that participants commented that they did know something about AI in general, but that they were less familiar with applications of clinical AI (Young et al., 2021).

Public opinion on the use of AI in medicine

Researchers have started to study public opinion on AI in healthcare, as this is a field where AI is likely to be implemented on a large scale in the future. As it turns out, even if an AI system is able to outperform human doctors, patients still want supervision by a doctor, both when it comes to diagnosis and treatment. In a study on screening mammography researchers were surprised to find that a vast majority of the women (77.8%) did not support fully independent use of AI-based diagnostic systems without the supervision of a radiologist (Ongena et al., 2021). It is important to note that this study took place in the Netherlands, a country that is known to be careful with AI, scoring highest in an EU-wide study on the need for careful management of robots and AI (TNS Opinion and Social, 2017). On the other hand, the Netherlands scores highest in awareness of the existence of AI and over 80% of respondents to surveys have said they have a positive view of AI and robots. This goes to show that especially when people do think that AI will be useful and have a positive impact, they tend to be more wary of it. This is particularly true when it comes to our health as a different study confirmed, in which a majority of people perceived AI as a positive development for the healthcare industry and that it could benefit patients, but they were reluctant to use AI for their own treatment (Fritsch et al., 2022). In addition, almost all respondents said to favour the human physician if the physician and AI come to different conclusions. This is remarkable, as other research has found the public to believe that healthcare AI is more intelligent than human doctors (Wu et al., 2023). Yet other studies have reported that participants perceived the main strength of AI to be in diagnosis, because of the ability to handle vast amounts of data (Nadarzynski et al., 2019; Nelson et al., 2020; Tran et al., 2019).

One central reason for this hesitancy is likely the lack of transparency. This is the most common major concern surrounding the use of AI in healthcare reported by patients (Banerjee et al., 2022; Ongena et al., 2020; Wu et al., 2023; Young et al., 2021; Z. Zhang et al., 2021). As mentioned before, ML algorithms, which are extremely common in healthcare applications currently in development and testing, have been characterised as black boxes because of how little we know about how they work. The first problem with this is that such algorithms are banned by law in the EU under article 22 of the General Data Protection Regulation (GDPR) as it stands. Even if this does change in the near future, it is not knowing how or why an algorithm makes a decision that causes people to be cautious. One systematic review from 2021 which included 23 studies on public opinion of the use of AI in healthcare came to the conclusion that people want to know for sure that it is accurate and how it exactly works (Young et al., 2021). Studies published since have found similar results, with participants in one study saying that in order to remove doubts about quality and trustworthiness they need an explanation as to how the AI arrived to its conclusion (Z. Zhang et al., 2021). In order to increase trustworthiness, and get people to accept AI for their own treatment too, it is thus vital that it is understood how the algorithms work (Banerjee et al., 2022; Huynh et al., 2020; Wu et al., 2023). This is especially important for the groups that tend to be underrepresented in the healthcare system (Panch et al., 2019; Zimmer et al., 2021), as those people often have a lower level of faith in AI systems to begin with (Gao et al., 2020). The reason for this is that the data used to train AI algorithms often comes from a Caucasian majority, and it may therefore not be as accurate on people from racialised minority groups (Panch et al., 2019).

The first concern about the lack of transparency ties in with a second common concern on the use of AI, which involves privacy and the sharing of data. The EU has strict rules and regulations set in place, but as many people are not familiar with these, it is a worry that still exists. Since we do not know how the AI system is coming to its conclusions, we also do not know what personal data is being used and how it is being used. One of the crucial traits of AI is the ability to 'learn', which could mean that it uses data from patient A to create a treatment plan for patient B. This is especially important in precision medicine, where the care provided is meticulously tailored to individual patients, for instance using genomics (Aronson & Rehm, 2015). One major part of this concern is who has access to this data, and not all parties are trusted equally by the public. Americans with higher education levels tend to accept the sharing of data with medical researchers, but are more wary when it comes to commercial companies and law enforcement (Beets et al., 2023). Interestingly, when it comes to AI in general, the American public does have a lot of faith in tech companies to manage AI, following only non-government scientific organisations and the Partnership on AI (B. Zhang & Dafoe, 2020). However, none of the five biggest tech companies (Amazon, Apple, Facebook[1], Google, Microsoft) are trusted as well as the entire sector, with trust being especially low in Facebook. Overall, most people would only want to share their health data with their doctor (Ghafur et al., 2020). Even if the data can be used to improve technologies and is anonymised, only around 10% of the UK and the USA populations are willing to share their data. This is in large part because people are less inclined to share data with commercial companies, potentially due to tech scandals such as Cambridge Analytica in 2018 (Ghafur et al., 2020).

[1] At the time of the study, the company was still called Facebook. It is now called Meta.

Despite there still being some concerns about the use of AI in healthcare, the public is largely positive about the potential of AI. However, in many of the studies presented, the participants were not presented with a clear example of an application of AI in healthcare. As discussed, the use of specific examples is necessary to properly study public opinion (B. Zhang, 2021). In this thesis, I will therefore study the public opinion of the use of AI in healthcare using an ethnographic film about the work of a pathology lab. The film, in which pathologists in a Dutch hospital are followed, explores the potential changes that may occur in the daily practice as AI becomes more integrated in their work. Previous studies have shown the value of film in the research on public opinion of AI in healthcare, as it provides a specific example of what the implementation may look like (Banerjee et al., 2022). Not only does it help to set expectations, audio-visual methods can also help people gain an understanding of what AI means, with a participant in one study commenting that she did not have a clear understanding of AI until she watched a video (Zimmer et al., 2021). Furthermore, while many studies on public opinion use surveys to collect data, in this study qualitative data was gathered through semi-structured focus group conversations, as I believe this provides more opportunity for participants to express their thoughts.

Methods

Several film screenings were organised for a variety of audiences, followed by focus group discussions to assess the perspectives of the public on the use of AI in healthcare. The use of focus groups meant that the discussions by default were of a semi-structured nature (Tong et al., 2007). Focus groups work well for a film discussion because it allows the participants to explore ideas that they may not have had themselves. As such, this method is well suited for discussion on topics in healthcare (Tong et al., 2007). In this study, we are thus able to investigate the public opinion on AI in healthcare after giving the participants a film to watch which provides background knowledge. The hope is that this allows for more in-depth conversations, with specific thoughts, concerns and comments, as well as further understanding of the use of film as an informative tool in research with the general public.

The film

This film, titled *Samples to Slides: Labor and Craft in Pathology*, was created by researchers from the interdisciplinary RAIDIO research project (Responsible AI in clinical DecisiOn-making) at Utrecht University and Maastricht University. The film makers followed pathologists at the pathology department of the Radboudumc in Nijmegen, the Netherlands, in order to highlight the labour, craftmanship and knowledge of a pathologist and the role that AI can play to the attention of a broader public, as their work is largely invisible (López, 2015). The goal of the film was to create an informational tool to showcase to stakeholders about pathology as well as the development of AI in image-based disciplines in medicine (Milota et al., 2023). The ethnographic film includes both observations of daily tasks, patterns and processes, and recorded interview material. Some stills from the film are included in this thesis as figures to augment quotes or arguments.

Data collection and analysis

For this analysis we showed the film to three different audiences, all with an interest in AI in healthcare. Each group had a different background, with pathologists present in the first group, academics and students in the second, and patients in the third. As such, the thoughts were obtained of people in three separate groups, which allowed the identification of the aspects of AI in healthcare that are most important to each group.

The screenings were held between April and June 2023. Participants were recruited in various ways, each best suited to the group. The pathologists were invited to attend the premiere of the film at the Radboudumc. The academic audience was gathered at the Making Together festival in Maastricht, organised by researchers from the Making Clinical Sense study. The patients were approached through the Office of Patient Engagement at the Univeristy Medical Center Utrecht. All attendees were present at the location itself. The focus groups were moderated by the creators of the film, Megan Milota (MM) and Jojanneke Drogt, and by the author. After watching the film, the participants were asked to give their first impressions and a semi-structured topic list was used to guide the conversation that followed (Appendix 1). The recorded conversations were transcribed using Amberscript and checked for reliability. Identifying information was subsequently removed from the transcripts. The conversations were conducted in either Dutch or English, depending on the members of the groups. Dutch quotes used in the analysis were translated to English by the author. Quotes included below were originally in English unless stated otherwise.

The data selection and analysis were iteratively done by constant comparison. The transcripts were read, and relevant quotes were highlighted. After two screenings, the fragments were grouped into descriptive categories, which created the first code tree. This code tree was then discussed with a member of the RAIDIO research team (MM) as a means to further refine the code tree. The relevant fragments from the third screenings were then added and discussed with MM, completing the code tree.

Data statement

The data have been presented through illustrative quotes, which were selected to represent some of the opinions given in the conversations and do justice to the variety of perspectives shown within them. In the selection, I have also considered whether the quotes could be understood without the context in which they were originally said. In the cases where they cannot but the quotes were deemed too important to be omitted, the context is provided within square brackets.

Ethical considerations

This research took place as part of the RAIDIO study. Ethical approval for the RAIDIO study was obtained from the Medical Research Ethics Committee (MREC) of the University Medical Center Utrecht and Radboudumc (WAG/mb/20/014090). The MRECs determined that this study was exempt from the Medical Research Involving Humans Act. Informed consent was obtained from all participants.

Results

A total of three screenings were held, with audiences ranging from four to 33 people, excluding moderators. The first group was members of the pathology department at the Radboudumc in Nijmegen (N = 33). The second group consisted of academics and students with an interest in AI in healthcare (N = 6). The third group consisted of patients (N = 4). Table 2 shows an overview of when and where the screenings were held, and how the groups were comprised. The pathologist and academic groups exclusively consisted of people in an age range between 20 and 67 years of age, as all were either studying or working. The patient group was mainly comprised of elderly patients. The exact ages of all participants were not obtained, as this was not deemed of great value to answer the research question. The content of the conversations is divided in six main themes arose, although not all six themes arose for every audience. The main themes are 'AI compared to automation', The uncertainty of AI', 'Trust in AI', 'The future of healthcare', 'Making the invisible visible', and 'The story-telling medium'. The latter five of these themes are comprised of several subthemes. Participants commented on the use of the film as an informative tool and the scenes that made an impression. The audiences also discussed the intricacies of pathology, that being the processes involved preparing a sample for a diagnosis and what the workflow reminded them of. The potential workings of AI in pathology itself and in a broader sense in healthcare and what this would mean for both healthcare professionals and patients also came up extensively.

Table 2: Overview of participants

	Date	**Location**	**N**	**Type of participants**
1	20 April	Radboudumc, Nijmegen	33	Pathologists
2	10 May	Making Together, Maastricht	6	Academics
3	12 June	UMC Utrecht	4	Patients

The pathologists of the Radboudumc, some of whom appeared in the film themselves, mainly focused on the contents of the film. After all, most are familiar with their own and their colleagues' modus operandi. As a result, most of them paid attention to the details of the film, such as whether the patient details on screen should not be blurred.[2] They were also looking out for any incoherencies in the film and whether they thought certain scenes could be understood by the general public. For instance, they thought that the intertwining of AI and automation could confuse people, which was a point that was also raised by the academics and patients. In the

[2] The patient details on screen were pseudonymised, meaning that no sensitive information is shown in the film.

discussion with the academic group, a lot of concern was expressed for skewed power relations and whether AI actually benefits the workers and the patients. The pathologists mentioned that it would be helpful to include positions of the speakers, so viewers can more easily identify experts. They however expressed no concern over a possible loss of jobs. The patients had a rather positive view on AI, feeling that it will both benefit patients and healthcare workers. They also felt that there is a need for AI implementation in healthcare in order to maintain the current level. The academic group, acknowledging that they were being cynical, figured that the main reason for the innovation is to generate more revenue. All audiences felt that the film itself was lacking some crucial background information, which may make it too difficult to understand for the general public and thus less suited as an informative tool in its current form.

Theme 1: AI compared to automation

Both the pathologists and the patients said that AI and automation were intertwined too much in the film. In one of the scenes, one of the pathologists discusses the automation of a large part of the workflow using AI-powered machines (Figure 1). However, the audience members of all three groups argued that while the two do not exclude each other, one should consider them as different entities. The pathologists highlighted the importance of the distinction, as it could be confusing for lay people to figure out what the goal of the technological advancements are (Table 3, Quote 1A). They believed that automated processes should increase efficiency and reduce workload, while AI-driven processes would carry out various types of analyses, such as in diagnosis. Participants in the other two groups had similar observations. Even if the automated process is powered by AI, a distinction should be made between the two entities. The explanation from both the academics and the patients was that in automation, one process is done in the same way over and over. AI on the other hand is exemplified by an ability to learn and interpret, and they believed that one should not refer to a process as being driven by AI if this important quality is missing (Table 3, Quote 1B, 1C & 1D). Some participants even went as far as saying that AI and automation are two completely different things and that they should not be mentioned in the same breath.

Table 3: Illustrative quotes for theme 1

	Quote	Said by:
1		
1A	"What caught my attention is that you are letting AI and automation get intertwined a lot, while these are totally different things. They may be partially connected, but I think this is very difficult for a lay person." (Translated from Dutch by author)	Pathologists
1B	"So the coupling of the machines, I did not see why the coupling of the machines is AI. Process flow is not, then you are calling everything AI. And then, there is no self-learning system behind these processes, when the machines simply go from A., you make a slice and continue to the next step." (Translated from Dutch by author)	Patients
1C	"I do think they are two different things, yeah. What you say because like, the, the one is just a machine working and you just give it a model and it will do the same every time again, yeah. And Artificial Intelligence can learn from the new samples given. So, that's, that's different I guess."	Academics
1D	"There is no interpretation [in process flow], AI means interpreting, self-learning." (Translated from Dutch by author)	Patients

Figure 1: Still from the film, showing some of the machines used in the pathology department.

Theme 2: The uncertainty of AI

A worry that came up in both the academic and patient group regarding the automated workflow had to do with reoccurring mistakes. As they mentioned, when a human pathologist makes an error on a single piece of tissue, it only affects that single patient. However, if the process is automated by means of a machine, the effects of a mistake may be more widespread, as it could take some time before anyone notices (Table 4, Quote 2A). The patients therefore argued that it is critical that the automated processes are faultless. On the other hand, they did not feel the need for this when it comes to diagnosis. One of the participants in the patient group referred an article by Kiani et al., which showed that pathologists were more accurate in diagnosing liver cancer when they used an AI tool compared to when they did it themselves without help (Kiani et al., 2020). For the patients, an increase in accuracy when using an AI tool is enough. They did not believe perfection in diagnosis is attainable and believed we should settle for improvements. They compared it to self-driving cars; there may still be some crashes, but there are less compared to human drivers. According to them, we should emphasise the strides that have been made rather than the imperfections that still exist (Table 4, Quote 2B). An even greater worry, that applies less to diagnosis and more to personalised medicine, has to do with the black box nature. Since we do not know what is happening inside the hidden layers, we do not know what data the algorithm is looking at (Table 4, Quote 2C). As such, unexpected results may come up and it cannot be known how or why this happened. This worry was shared by both the academics and patients but did not come up in the pathologists group.

Table 4: Illustrative quotes for theme 2

	(Sub)theme	**Quote**	**Said by:**
2	The uncertainty of AI		
2A	Scale of errors	"Is there the worry that if that happened [a mistake] on a human level, the scale is of any sort of disruption is going to be fairly minimal. But if it is sort of industrialised, then the disruption is industrialised. Is that a concern?"	Academics
2B	Focus of the public	"You would need properly, but of course, that is the education, because we are constantly focusing on the 5 percent that is still going wrong instead of the 14 percent that used to go wrong." (Translated from Dutch by author)	Patients
2C	The black box nature	You don't know what the AI does because it's like, it works in a way that it's like, it's really like we learn about this, like it's a box, so you don't really know what happens inside the box. … Like not knowing what happens inside, that's what scares people I think, because maybe it focuses on something different, which we hadn't planned, which we don't want it to, but that makes it give a different outcome than expected.	Academics

Theme 3: Trust in AI

Safety remains a concern for the patients, but once these issues have been sorted out, they saw the tremendous benefits that AI has to offer in healthcare. Part of this issue of safety is indeed not knowing how the neural networks of a complex AI algorithm work. However, as pathology is largely an image-based field of medicine, the patients did not see it to be a major concern in this area. As long as the doctor is able to point out what was highlighted by the algorithm, they are willing to trust it. This diagnosis must however still be checked and presented to the patient by the doctor (Table 5, Quote 3A). The academics also had trust in the use of AI in diagnosis, but they had a different reason for this. They do not necessarily trust the algorithm itself, but they trust the expertise of the people who develop and use it. In clinical use, the inability to decipher an algorithm's train of thought is seen to be more concerning, but they believed that part of the successful implementation is having faith in the process (Table 5, Quote 3B). In cases where the physician and the algorithm would come to different conclusions, the patients would first and foremost want to know why this happened. In diagnosis this would mean making sure that both studied the exact same sample, confirming that no mix-up occurred. If both the algorithm and the physician did indeed look at the same sample, they would rather have a second round of tests, rather than living in doubt. The academic group was less inclined to be as accepting of AI in the clinical use, as they believed that part of the progress is being made for the sake of progress (Table 5, Quote 3C)

Table 5: Illustrative quotes for theme 3

	(Sub)theme	**Quote**	**Said by:**
3	Trust in AI		
3A	Check by human doctor	"I would personally, if it was my biopsy and it was looked at by a machine, I would really appreciate it when I visit the doctor that he could show me, then I know for sure check check double check, he agrees too, this is what is going. I would find that very important, I wouldn't just …" (Translated from Dutch by author)	Patients
3B	Trust in the process	"You know, I am from the time of automation and part of it is just having trust in the process." (Translated from Dutch by author)	Patients
3C	Progress for the sake of progress	"Are you also, maybe to add something on this? I think it's about progress, but is progress always in a good direction?"	Academics

Theme 4: The future of healthcare

The academic and patient groups also discussed the impact that AI may have on healthcare in general. While they agreed on certain aspects, there was a significant disparity too. The academic group was more cynical in their reasoning as to why AI is being developed for use in healthcare. They argued that money was the biggest motivator for hospitals. AI makes processes more efficient and more accurate, which presents an excellent business case (Table 4, Quote 4A). The fact that AI can see things that the human eye cannot on scans certainly helps to improve healthcare, and they would like to believe that the goal is to better help people. However, they did think that the financial gain is the most important reason for developers to invest in AI in healthcare. The patients however felt that there is a need for AI in healthcare. With the growing staff shortages in healthcare and an aging population, which often comes with more illness, the current healthcare system simply cannot maintain the same quality of care (Table 4, Quote 4B). Regardless of whether it presents a solid business case, AI is needed in healthcare or else people may suffer in their opinion. In addition, they believed that the use of an automated workflow provides some considerable benefits. There is no need to give machines or algorithms days off and they cannot have a clouded judgement due to a bad mood. However, the patients did stress the need for human supervision along the entire process, even if it is automated. It cannot be the case that AI will replace humans, it must be used as a tool to provide better and more efficient care. Especially the communication with patients has to remain a human endeavour, as the patient needs to have the opportunity to let the message sink in in a comfortable environment, where they have the opportunity to ask questions (Table 4, Quote 4C). This is quite the contrast to the picture painted by the academic group of a dystopian future in which one would not encounter any humans in the hospital (Table 4, Quote 4D). The pathologists did not comment on how the implementation of AI may affect their line of work, or what they thought a hospital might look like in twenty years.

As the patients pointed out on numerous occasions during the discussion, communication is essential in healthcare, and this must be done human to human, so a fully digitalized hospital did not even occur to them. They did however see benefits with an increased level of digitisation. If all scans are digitalised and saved, and an algorithm is able to learn and improve its diagnosis, it could check all old samples once or twice per year to see whether it would change the diagnosis. In that case, the patient could be contacted if something does seem out of the ordinary in hindsight, potentially before it is too late (Table 4, Quote 4E). The academic group did not see this as progress in the right direction, however. They believed that being able to test for so many different variables and being able to predict disease before it has even occurred may disrupt the bounds of abnormality (Table 4, Quote 4F). For instance, the question as to whether having a predisposition for a certain disease requires intervention when the patient is not ill yet came up. They thought it did not and they believe such cases should be handled carefully. The academic group also wondered what patients would think about algorithms analysing their biopsies, rather than human pathologists. Part of their questioning was that they felt that the patient perspective was missing from the film. As it turns out, the patients in this study were not bothered by this and did not feel a need to be informed of it either. Their only requirement was that they know why a certain diagnosis arose, for example by being presented with an image. As long as they know that the doctor checked it, agrees with the diagnosis and presents it to them, they did not mind an algorithm doing some of the work.

Table 6: Illustrative quotes for theme 4

	(Sub)theme	**Quote**	**Said by:**
4	The future of healthcare		
4A	Need for AI	"I think one of your respondents on there already answered that question when you mention the business case. Yeah, whatever saves or makes money."	Academics
4B	Need for AI	"Yes exactly, you simply cannot keep going like this, with the staff and people getting older and sicker, yes…" (Translated from Dutch by author)	Patients
4C	Change of the system	"But then it also needs to get through to the patient, because a lot of people get startled from such a sudden message, so that needs to get through to them." (Translated from Dutch by author)	Patients
4D	Change of the system	Yeah, but if you, if you get an operation, you go like they put a barcode on you, you go in, there's a computer doing the search. There, there, there are already robots that can, that can operate you. And then that piece goes into a machine, and I think that, it will be processed. Also. You get your answer quicker but, are you going to see a person while you're going to go to the hospital, maybe in like 20 years, you just go into your self-driving car, you get into the you're like on a, there's a robot operating you and bleep bleep in your automated, in your automated car. You get on your big computer or even on your phone, probably you get the results of your scan or whatever.	Academics

4E	Bounds of (ab)normality	"When everything is digitalised, you can go back and scan the past again. And then maybe you see something that was fine at first, then a year later you receive a message like, oh you should come back, because we noticed something new." (Translated from Dutch by author)	Patients
4F	Bounds of (ab)normality	"My general like hesitance with regard to AI and or in diagnosis is that, is that there's, it, it, offers a degree of certainty which, or I think maybe it's about scale or whereas like pathology is, becomes it's sort of, sort of like zoomed in on and then and the scale of what's normal and what's, what's pathological gets pushed further and further and further. And AI has the capacity to do that much more than like, than in sort of like human sensing. Well, there is the threat that I, don't know, is that a threat? I don't know. ... Just changes the bounds of normality."	Academics

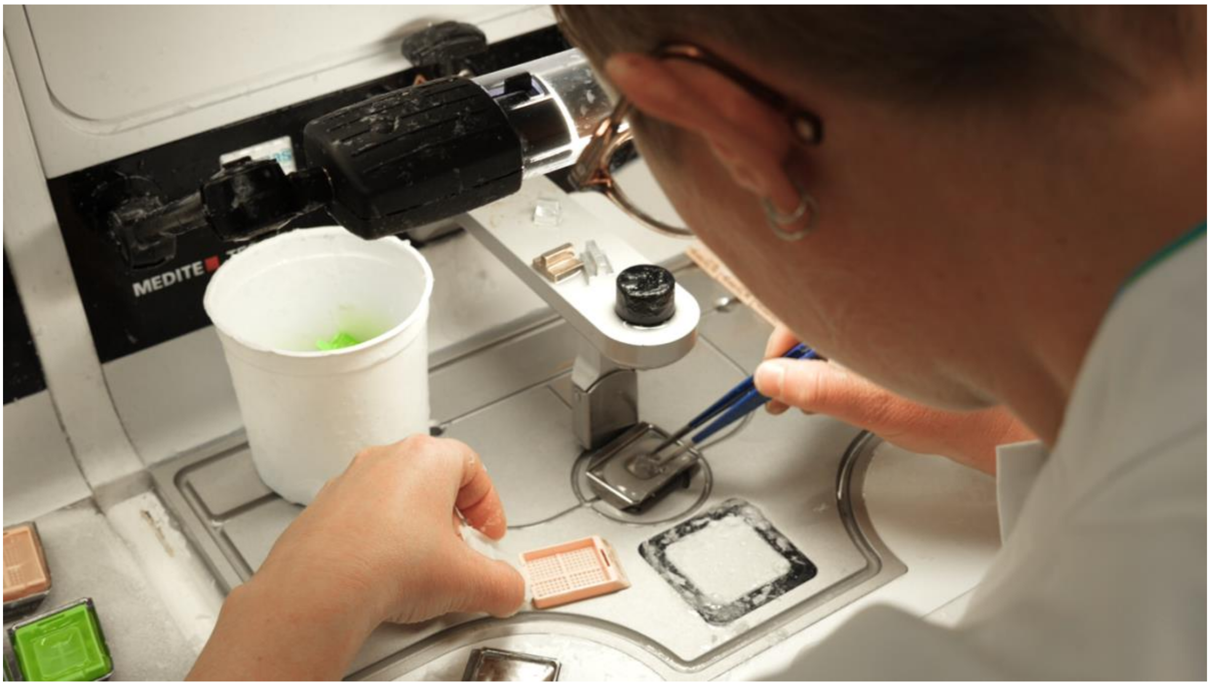

Figure 2: Still from the film, showing the manual process of embedding tissues.

Theme 5: Making the invisible visible

One point that the pathologists were adamant on making, is that the film only shows a single facet of the field of pathology. The film showed the process that a biopsy would follow, from being prepared for analysis by cutting, colouring, and slicing, to the analysis under a microscope and finally a diagnosis. The film shows an insightful behind-the-scenes view of the processes that go on in the pathology laboratory, but does only provide a partial picture, as cell biology and molecular diagnostics also form part of their expertise (Table 5, Quote 5A). Remarkably, in a film that discusses the newest technological advancements in the field of pathology, both the academic and the patient audiences were reminded of old-school factory layouts, somewhat to their own surprise. They compared it to textile manufacturing and the Ford Motor Company production lines of the first half of the 20th century (Table 5, Quote 5B & 5C). The fact that a lot of the sorting and cutting processes are done by hand and accompanied by old-fashioned handwriting on a piece of paper was also surprising to both audiences. The patient group was especially impressed by the pathologists' ability to keep up a high standard of quality, with the amount of manual labour that was done (Table 5, Quote 5D; Figure 2). The pathologists themselves were not as surprised nor impressed, but they did appreciate that the film captured the craft that goes into their everyday work, which is something they do not regularly see from an outside perspective.

In line with the criticism that the film does not capture the complete picture of pathology, the pathologists who are familiar with the process that was shown in the film did find the order to be somewhat disjointed, with certain procedures appearing to be intertwined even though they are not in practice. This mainly came down to the omission of various steps on screen, such as the colouring of the sample, as well as the presence of establishing shots of the hospital interior at the start of the film (Table 5, Quote 5E). On the other hand, they also wondered whether someone needs to know and understand all the steps in the process to gain an idea of what is in a broad sense going on in a pathology department. Nonetheless, the patients did also notice that the process shown was not in chronological order at all times and noted that this did not help them in following along. They did however remark that the explanation of a particular diagnosis may be too difficult to understand for most patients, let alone an explanation of all the steps taken to reach that diagnosis.

Table 7: Illustrative quotes for theme 5

	(Sub)theme	Quote	Said by:
5	Making the invisible visible		
5A	The image of pathology	"This is a particular facet of pathology, we do a lot more than this." (Translated from Dutch by author)	Pathologists
5B	The process	"It reminds me of textile manufacturing. The banks of machines."	Academics

5C	The process	"Yes, what I said earlier, I was disappointed by the process flow. I was reminded of the videos from the 30s in the last century. Of a Ford factory, you now, when everything was being automated, then I think, how can this still be happening with all those assembly lines, that we are still almost, to my eyes it seems very old-fashioned, despite this being done with all these machines." (Translated from Dutch by author)	Patients
5D	Craftmanship	"By the way, it surprises me, the amount of manual operations, the constant changes and I am watching the film, thinking wow, that they manage to do this well every time." (Translated from Dutch by author)	Patients
5E	The process	"And potentially, well the colouring was not shown, but that could be at a later point. One expects a pathologist to tell a story, and that was pulled forward, so you are misguided in how the process happens. I can imagine that, well, I experienced this in the first two, three minutes, you are pushed in a certain direction with some shots, which is then followed by something that actually happens in a later stage. And then we feel that things start to intertwine. Yes, that is maybe a little different for a different audience."	Pathologists

Theme 6: The story-telling medium

All groups thought the film was informative in the sense that it is able to show the invisible world of pathology, but they felt it was lacking in the amount of AI that was shown, in large part because they believed that automation should not be considered to be AI. The research project for which the film was created focuses on the ethics of AI in healthcare, but the pathologist audience felt that the ethical aspects of the use of AI were missing in the film. They acknowledged that the film provided a wonderful insight into what the ins and outs of the pathology department are, but that the potential of AI was only discussed superficially. A similar view was held by the academic audience, for whom the only noticeable aspect of the use of AI in the film was when the data scientist showed an AI tool that grades a tumour biopsy using colour (Table 6, Quote 6A; Figure 3). As mentioned, the other processes in the film should be considered to be automation, rather than AI in their opinion. The patients did not feel as strongly about this lack of AI, but also agreed that the colouring of the tumour was the clearest example of the use of AI in healthcare (Table 6, Quote 6B). What they believed was mainly lacking from the film was a voice-over explaining the processes shown. They did believe the film is useful as a tool to showcase the use of AI in pathology, but in its current form it does not explain the use of AI. In order to show it to patients and expect them to understand what is going on, a simple voice-over is essential in their opinion (Table 6, Quote 6C).

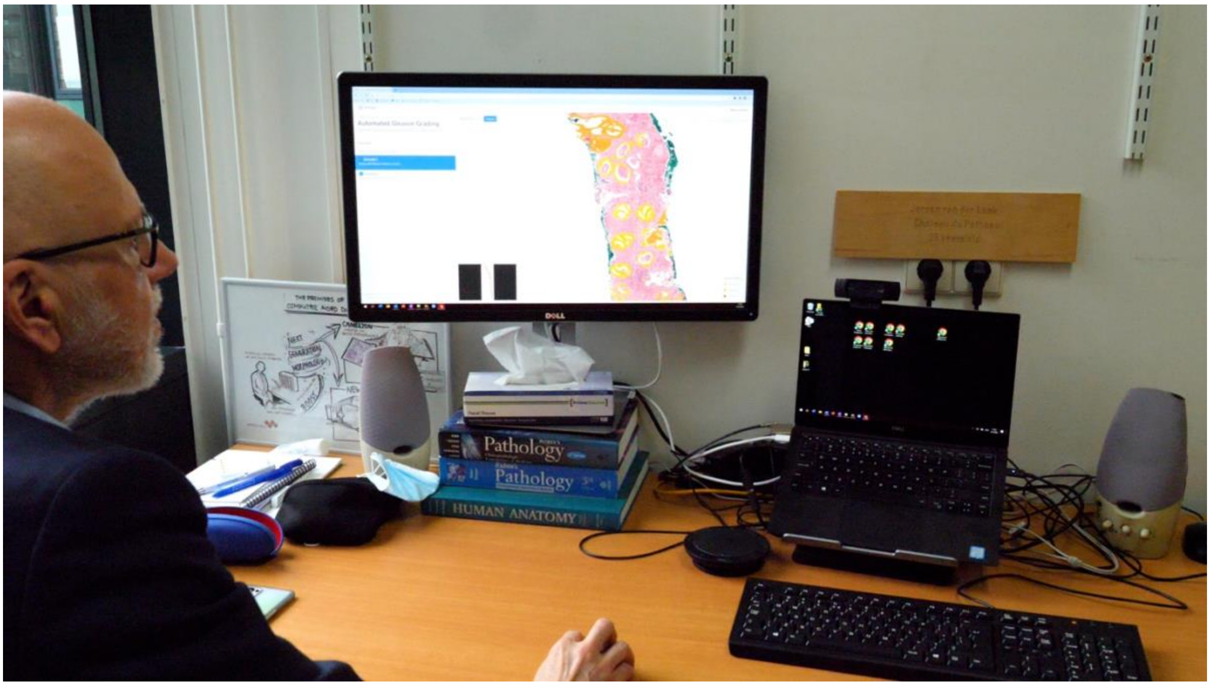

Figure 3: Still from the film, showing an algorithm that gives colours to various grades of a tumour.

It was the parts where one of the pathologists on screen were explaining something that stuck with the patients the most, and these parts were thus discussed most extensively. One example of this is when the head of the department explained that pathologists do not cultivate tissues, but rather process and study them (Table 6, Quote 6D). The parts that were not explained were less clear, as some of the pathologists commented that they did know what was going in certain scenes on as that particular aspect of pathology was not their area of expertise, which made it difficult for them to follow along (Table 6, Quote 6E). Another pathologist agreed with this, commenting that they missed what the devices were used for. Furthermore, both the pathologists and the academics felt the need for the inclusions of the roles of the speakers in order to assess how trustworthy the statements are that each of them made. They figured all the speakers are experts in their own right and were therefore wiling to trust them but did feel like the film only offered the view of those in charge, and not so much of the regular workers, whose livelihood may be affected most by the implementation of AI (Table 6, Quote 6F). Despite the various critiques, all participants did recognise that the film is a great starting point to have a discussion on the ethics of AI in healthcare, and what it may look like.

Table 6: Illustrative quotes for theme 6

	(Sub)theme	Quote	Said by:
6	The story-telling medium		
6A	Lack of AI	"For me, the, the artificial intelligence part in this movie was only the yellow and orange. That was the, which made it really clear how it works and how the pathologist uses it. But that was only a, and the rest, I think was all about more about automation." (Translated from Dutch by author)	Academics
6B	Informative	On the same point, the clearest point of this movie, is the colouring of the prostate biopsy, it shows what AI can do, and for patients, the workflow being automated, yes …" (Translated from Dutch by author)	Patients
6C	Informative	"Yes, the film can do that, but then I am missing the voice-over, then it would have been clearer. If at least you want to tell a clearer story, then that is, I think, if we had that, we would have a clearer image." (Translated from Dutch by author)	Patients
6D	Informative	"What I found to be clear, is that they do not cultivate it, right, that is always what you think, that it is being cultivated. I found that to be very strong in the film." (Translated from Dutch by the author)	Patients
6E	Informative	I really have no clue that they are doing here and that makes it quite difficult to place for instance, what stage of the process am I looking at, is it already something, are they cutting something different than what they were cutting just now? And what part was AI supposed to do for them, and I could not follow it anymore." (Translated from Dutch by author)	Pathologists
6F	Power relations	"But if you're going to like automate the 75%, what's going to happen with this 75% of jobs that are in there? […] I did not see the faces of the people, maybe wondering about what's going to happen with that 75% of the jobs that are going to be gone."	Academics

Discussion

This study adds to the existing literature on public opinion on AI in healthcare but sets itself apart by providing a realistic example of AI implementation in pathology. Overall, despite the criticisms on the film in its current state as an informative tool, it did inspire meaningful conversation across all three groups. The non-pathology audiences see the added benefit of using AI in pathology, although the academic group sees more caveats than the patient group. The patients were enthused to see AI become a part of healthcare as a tool to assists doctors, provided it is accurate and safe to use. The academics are scared that using AI in diagnosis may disrupt the bounds of normality by using data to predict disease far before it may occur and that it may lead to a great loss of jobs. The pathologists did not comment a lot on the use of AI itself, but rather on how pathology was portrayed in the film. A possible reason for this is that the use of AI is part of their daily work and thus not as new as it may seem to other people outside of the pathology laboratory.

What should be classified as AI?

All audiences felt that AI and automation were overlapping too much in the film, as they believe that the two are not the same thing and should in fact be considered as separate entities, even if they are connected at some points. Doing this is however easier said than done. This is because AI does form a large part of automation processes, such as the speech-to-text software used in the pathology department of the Radboudumc (Milota et al., 2023; Figure 4). Indeed, a digitalised workflow is essential to even begin thinking of implementing AI systems into a laboratory (Topol, 2019). Based on your definition of AI, one could classify certain machines and software either as AI or simply just as automation – even if it needs AI to work. In the example of speech-to-text software, the algorithm is interpreting what is being said in order to form coherent sentences and can learn to recognise new words if the dataset is updated. It can recognise tone and sentence structure and is interpreting what is being said and how it is being said to do this. It can even summarise the texts. In such cases, one could argue that the algorithm has created nothing new. It took the words that the pathologist said, wrote it down and maybe paraphrased it too. This could prove incredibly useful in terms of efficiency, but the tool is not of any use if the pathologist makes an error, as it will naturally write down anything the pathologist says. While such a system may not sound very intelligent, it does exactly what it needs to do, namely reducing workload and increasing efficiency, using AI.

Figure 4: Still from the film, showing a pathologist studying a sample whilst dictating into the microphone.

Thus, as it turns out, separating AI and automation is not as straightforward as it may seem. One could wonder why all three audiences from completely different backgrounds still felt compelled to make a distinction between the two. It is likely that this comes down to a combination of two things; on the one hand the different depictions of AI in the film, with a diagnostic tool showing different colours for different stages of cancer and various other tools being used to make the preparation process more efficient. On the other hand, is the human tendency to categorise things, as this helps us understand the world (McGarty et al., 2015). It is an incredibly useful system because it provides a large amount of information while costing little energy (Rosch, 2004). We thus do it without noticing ourselves. While there still is debate among scholars about how it exactly works, the basics come down to us using a set prototype, and we use the features of this prototype to examine whether another instance fits in this same frame (McGarty et al., 2015). Therefore, when the viewers see an example of AI determining the grade of cancer in a biopsy, they have unconsciously created a category in which AI in pathology must fit. It does something that one would consider difficult, that one needs intelligence to master. In the film, pathologists are heard dictating what they see, and this is then transcribed by AI. As mentioned, this system does meet the criteria set by the audiences for AI systems but does it in a far more invisible way. However, it does not seem as difficult a task as diagnosing cancers and more importantly seems to work in a completely different way, so we are inclined to not consider this to be as intelligent. Even if in essence both systems come down to pattern recognition. Another example of an easy task that the viewers would classify as automation rather than AI would be the slicing of samples. As it is the same process over and over, it seems simple. Indeed, while AI developers define AI by its technology and functionality, those less familiar with the techniques define AI by comparing it to human cognition (B. Zhang, 2021). It must be mentioned that the patients were impressed with the pathologists' ability to consistently execute such 'simple' tasks well, meaning that they do acknowledge that even those tasks require considerable skill. Skill that a machine would need too, for it to successfully complete the same tasks. In terms of the distinction between AI and automation, it seems that the vast forms and uses of AI are difficult for us humans to comprehend, because we want to categorise it. This is not a bad thing, it is simply human nature and can still be done. However, perhaps the distinction in medical AI should be made at another level.

The use of AI in the pathology department – in all its various forms – all serves the same purpose: to get a more accurate diagnosis to the patient in less time. This process is relatively straightforward in itself, by being relatively disconnected from the rest of the hospital. Samples are prepared and then analysed, and it is clear what the pathologists and algorithms are doing and looking for, even if the steps taken by the algorithm are not fully understood. It will always operate in a set window of the available tissue, that being the biopsy taken from the patient. Another example of such stand-alone use of AI in healthcare is in drug discovery. In 2018, researchers created a program for drug–target interaction (DTI) prediction which showed remarkable performance (Hie et al., 2018). Other, less targeted uses for AI in healthcare could be in the creation of treatment plans and prediction of disease. One of the first challenges with such uses is the implementation in the clinical workflow and Digital Medical Files (DMF) (Davenport & Kalakota, 2019). This is said to form an even greater challenge for widespread AI implementation than the current inaccuracies in treatment plans. A second issue is that of the collection and use of data. The more data on the patient is gathered, for instance using biosensors in smartphones or smartwatches, the better an algorithm can predict outcomes and create a treatment plan (Davenport & Kalakota, 2019). The creation of a functional interface again forms a challenge here, but also the question as to whether people want so much data to be gathered. This remained unanswered during the conversations, with no participants commenting on how much data they are willing to share for their own and other people's good. In the cases where a lot of data is gathered, it is a lot less clear how the AI program is interpreting the data, and the lack of transparency becomes a much greater concern. On the other hand, if so much data is gathered, it is impossible to use without the use of AI (Topol, 2019).

How near is the future of healthcare?

It cannot be denied that AI has the potential to revolutionise healthcare like nothing before it, due to the many uses in administration, diagnosis and perhaps treatment too (Davenport & Kalakota, 2019). Yet there are still plenty of obstacles that must be overcome. The story of IBM's Watson is an example of this. Watson used to be a widely used example of the capabilities of AI in medicine. Watson is not a single algorithm, but rather a collection of 'cognitive services' (Davenport & Kalakota, 2019). This system has indeed been shown to be successful in various applications, such as recognising a rare secondary leukaemia by myelodysplastic syndromes (Otake, 2016) and diagnosing breast cancers (Somashekhar et al., 2017). In 2015, it took experienced doctors and nurses several days to correctly diagnose a rare disease, while Watson only took several minutes (Lorenzetti, 2016). The program was also able to create personalised treatments, but these were shown to be erroneous in some cases, such as recommending a medicine which causes bleeding as a side-effect to a patient with severe bleeding (Topol, 2019). In addition, it turned out that it was difficult to teach it particular types of cancer and the integration into existing care systems was challenging too (Davenport & Kalakota, 2019). What once was one of the most promising AI tools for healthcare and a textbook example of its capabilities, has since been discontinued (Lohr, 2021). Along with the suggestion of wrong or unavailable treatments and it being trained with data from only American citizens, one of the major issues with Watson was that it excelled in nothing in particular. With more specialised programs being developed, some of the issues that Watson faced may be resolved. Still, it is a perfect example of the challenges that do exist even when an AI program is showing great potential. One of the patients commented that they thought ten years was a long time to automate some processes and that it could be implemented far earlier, one of the academics predicted a fully robotised hospital in twenty years' time. While the field of AI in healthcare has progressed massively in the past years, some of the examples mentioned are seven or eight years old. It has only recently gotten the public's attention and to a certain extent its approval, but all this means is that all developments are under a lot more scrutiny. In 2019, Topol stated that "the state of AI hype has far exceeded the state of AI science" and while the science of AI has progressed, the state of hype may have gotten even greater (Topol, 2019). It thus seems unlikely that the predictions made by the participants hold any ground.

One common reason for fear and opposition to AI, also from healthcare professionals themselves, is a potential loss of jobs. A recent report from Goldman Sachs estimates that a quarter of jobs in healthcare could be automated by AI, and that AI could lead to 300 million jobs being lost worldwide in all sectors (Hatzius et al., 2023). According to the report, about a quarter of all jobs are exposed to being automated by AI. This number is far greater than it was in 2017, when researcher from McKinsey&Company estimated that 5% of jobs could be replaced by new technologies, although they guessed that 36% of jobs in healthcare could be automated (Manyika et al., 2017). There is therefore undoubtedly a good chance that automatization by AI will cause workers to lose their jobs and this may be the case for healthcare professionals too. However, especially in western Europe this might be less of an issue due to the current and future staff shortages (ABF, 2022), where AI implementation could actually reduce job losses. Since the COVID-19 pandemic, almost 40% of healthcare workers have seen colleagues quit due to the high pressures (Van Essen, 2021). If AI applications are able to reduce workload, less healthcare professionals may be inclined to quit their jobs. Regardless, also in other sectors AI could provide jobs rather than cause a loss of jobs. A research team at Deloitte found that in the U.K., between 2000 and 2015, 800,000 low-skill jobs were lost due to automation, while 3,500,000 new, higher-skill jobs were created (Sproul et al., 2015). Thus, while it is likely that some jobs will disappear in the future due to AI, new ones will appear, in healthcare too. More significantly, the importance of human involvement in healthcare was stressed especially by the patients. Even if AI could replace many jobs in healthcare at some point in the future, this is not something that the participants in this study want.

The use of the film

Most participants agreed that the film is able to the clearly show what happens at the pathology department in an academic hospital. Getting to see snippets of the generally invisible world of pathology was appreciated by the audiences, even by the pathologists who are familiar with their own work but had never seen it from such a perspective. By visualising the processes, the members of the audiences get to compare the images to familiar concepts, in order to better understand what they are seeing. As such, one of the patients was reminded of the assembly lines introduced in Ford Motor Company factories over a century ago while watching a film on one of the most technologically advanced fields of medicine. This may seem counter-intuitive to some extent, but this blending of concepts helps us understand the world. What happens is we combine one concept we know well with this new, unfamiliar concept, creating a mix of the two that we hope to understand (Eppe et al., 2018). The difficulty of this habit is that it is subjective; each person creates their own conceptual blend based on their own knowledge and experiences. This causes people to interpret what they see in different ways. For AI this is particularly challenging, as it comes in so many forms and shapes, that it can be blended with many vastly different concepts. The description of the robotised hospital is in essence quite similar to the old factory, but it has immensely different consequences to the people who make these connections. It would this be helpful to control what people think of when they watch the film by providing additional explanations. In its current version the film does not properly explain the processes that are seen on screen, thus leading to the viewers trying to explain it to themselves. Therefore, the current film is not best used as an informative tool, but rather as a behind-the-scenes at a pathology department. The audiences provided plenty of feedback with which the film can be transformed into an informative film. This mainly came down to including simple voice-overs aimed at lay people and adding descriptions for the speakers and machines seen in the film. By providing essential background knowledge, the film can be understood by a broader range of audiences. Nonetheless, in the current state, the film offered a great starting point for discussion, provided moderators with expertise on the making of the film are present.

The primary purpose of the film was to convey the invisible, everyday work of pathologists to a broader audience. It captured the craftsmanship, labour and skill that is involved in the daily tasks very well and this was appreciated by all audiences. It does not provide a full picture, nor does one necessarily understand what they are looking at, but it does successfully make pathology visible. Ultimately the film succeeded in its primary use and should be used as such. It can also be used as a starting point for discussions but lacks in portraying the context to an unknowing audience.

Limitations and recommendations for further research

The film was not intended to be on AI itself, but rather on the work of a pathologist and the role AI can play in this. In addition, with it being an ethnographic film, there was little context added to the images on screen. Without explanations of what process the viewer is looking at, it is difficult to fully understand the activities in pathology and the implications AI could have. As such, it was not the best suited to study opinions on AI in healthcare, as it was simply lacking essential background information. There were various scenes of interviews with members of the pathology department in the film and these were well-received by the audiences. The context given by the interviewees was helpful and the viewers found these to be the most informative parts. However, the fact that a true to form ethnographic film should not have any interview data in it whatsoever, tells us that this genre of film is not best suited for informational or educational purposes. In such cases, more is indeed more. This study tried to combine two goals, namely studying public opinion on the use of AI in healthcare and assessing whether a film works to inform viewers and guide the conversation. While the film did allow the study of public opinion, it was deemed to be complicated to educate viewers on the processes they were seeing on screen. In order to inform lay people of the uses of AI healthcare, the film should be simplified, or a different film could be used. Film remains a viable method as this film did indeed succeed in explaining certain aspects of pathology and AI, especially with the interviews.

With most members of the audiences being highly educated, the film could still be used as a starting point for the discussion, as they all could follow along enough to have a basic understanding. However, this does not make for a varied audience. Their opinions may be different from lay people and the study may therefore not represent the full public opinion. Showing this film, or a different version of it, to a greater variety of audiences may lead to new and different findings. This can be amplified by having more structured conversations. In this study it was chosen to let the conversation be guided by the audience, intervening only when deemed necessary. In order to have a more focused conversation, one could introduce certain topics or concerns to the group and ask for their reaction. It is indeed important to continue these conversations, both because public approval must remain if AI were to be implemented on a large scale and because the general public is still lacking in its knowledge of AI.

Conclusion

This study adds to the existing body of literature on the public opinion on AI in healthcare. By using a film as a starting point for the discussion, the aim was to have a more in-depth conversation on specific uses of AI, in contrast to much previous work which discusses AI in healthcare in very general terms. This worked to a certain extent, as people will still use previous knowledge and past experiences to form their opinions. The difficulty that this creates is that there is no equal level of understanding what AI is, especially since the film did little to help. As such, the audiences created connections between what they were seeing and what they have seen before, because these associations helped them understand the new concept. The difficulty with AI is that this is such a broad term with many different applications, that the connection falls short of what it can actually do, as it is put in a box in which it does not fit. This was exemplified by the fact that in the eyes of most participants, AI must complete difficult tasks to 'earn' the title of AI. Simpler tasks must be referred to as automation, even if the algorithm behind it makes use of technologies that one would consider to be AI, such as ML. Even with this limited knowledge of AI – in which these audiences are not alone, as many non-computer scientists struggle with this too (Yang et al., 2022) – the members of the audiences were positive over the use of AI. Most see considerable benefits, for both patients and healthcare practitioners. Nonetheless, they are aware of the risks with transparency and privacy, but especially the patients have faith that this will be solved before mass implementation. This mass implementation needs to happen alongside doctors, not instead of doctors. The human element of healthcare was emphasised by those not working in healthcare, and this should never be replaced. While the film did generate these discussions and the audiences agreed that it is a great depiction of pathology, they had trouble following along due to a lack of explanations.

Overall, it is clear from this study that AI remains a concept that is difficult to grasp, both for professionals working with it as for academics and patients. However, a complete understanding of AI is evidently not needed to spark debate about its use in healthcare. Even if the points raised are unrealistic or wrong, they must still be taken seriously. For AI to be successfully implemented in healthcare, most of the concerns must be taken away. This can only be done through continuous conversation with stakeholders, and film has proven to be an excellent way to start this.

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Appendix

Appendix 1: Topic list and guiding questions for the focus groups

Thoughts on AI in healthcare.

- What did they know?
- What do they know now?
- Any ethical or other concerns after watching the film?
- Has the film provided any new insights?
- Has the film changed how they think about the use of AI in healthcare?

Thoughts on the use of the film.

- Did the film help them to think about AI in pathology?
- Has it cleared up any unclarities surrounding the use of AI in healthcare?
- Do they think the film is useful as an informative tool?
- What is missing from the film?
- Reflection on scientific value of the film.

Thoughts on ethical concerns surrounding AI in pathology.

- Who bears the responsibility in a diagnosis?
- What will AI mean for the training of pathologists?
- Will there be enough specialized technicians to oversee the technologies?