

Reporting of Screening and Diagnostic AI Rarely Acknowledges Ethical, Legal and Social Implications: A Mass Media Frame Analysis

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Abstract

Introduction. Healthcare is a rapidly expanding area of application for Artificial Intelligence (AI). Although there is considerable excitement about its potential, there are also substantial concerns about the negative impacts of these technologies. Since screening and diagnostic AI tools now have the potential to fundamentally change the healthcare landscape, it is important to understand how these tools are being represented to the public via the media.

Methods. Using a framing theory approach, we analysed how screening and diagnostic AI was represented in the media and the frequency with which media articles addressed the benefits and the ethical, legal, and social implications (ELSI) of screening and diagnostic AI.

Results. All the media articles coded (n = 136) fit into one of three frames: social progress (n = 132), economic development (n = 59), and alternative perspectives (n = 9). The vast majority of the articles were positively framed, with 135 of the articles discussing benefits of screening and diagnostic AI, and only 9 articles discussing the ethical, legal, and social implications.

Conclusions. We found that media reporting of screening and diagnostic AI was overwhelmingly positive. Screening and diagnostic AI may be represented more positively in the mass media than AI in general. This represents an opportunity for health journalists to provide publics with deeper analysis of the ethical, legal and social implications of screening and diagnostic AI, and to do so now before these technologies become firmly embedded in everyday healthcare delivery.

Background

In the broad field of Artificial Intelligence (AI), healthcare is a rapidly expanding area of application (1), enabled by increasing volumes of digital healthcare data, as well as developments in computing power and technologies which allow this new data to be processed (2). AI tools including machine learning, natural language processing, speech recognition, computer vision, and automated reasoning techniques (2) show promise for application in healthcare contexts (3, 4). Research into healthcare AI describes significant investment in the potential of these new technologies to change the way healthcare is delivered, and considerable excitement—or even hype—about this potential (5). The technologies in development and testing stages are diverse in application: using computer vision to interpret medical imaging, using machine learning techniques to identify biomarkers for disease, developing speech recognition technologies so computers can act as counsellors, or creating robots that can perform surgeries autonomously (6). Emanuel and Wachter (5) describe this optimistic vision of a revolutionised healthcare as the catalyst for substantial venture capital investment.

One area of particular interest for AI application in healthcare is screening and diagnosis, where significant advances have been made in the last half-decade. Machine vision in radiology is especially well-advanced (7), and AI is likely to be integrated into image-based screening programs such as breast screening in the near future (8). AI development is also relatively mature in cardiology, with machine

learning applications being used for example to augment echocardiography reading, to process nuclear cardiography images, or to combine image reading and clinical data to produce diagnostic recommendations (9). Screening and diagnostic AI augments, or in some cases potentially replaces, clinical skills and practices that have traditionally been central to medical identity and professional responsibility (3). These technologies also seem likely, in future, to determine or at least influence the pathways of care that open and close to patients. Given these clinically and professionally important roles and impacts, the use of AI for screening and diagnosis is arguably of special significance. In this paper, we present a systematic analysis of media coverage of AI for screening and diagnosis, to understand the ways in which these technologies are being framed, especially for the general public. This analysis was particularly informed by an interest in the ethical, legal and social implications (ELSI) of these technologies, an issue to which we now turn.

The Ethical, Legal, and Social Implications of AI in Screening and Diagnosis

A number of authors have raised questions about the ethical, legal, and social implications of screening and diagnostic AI. For a more detailed description see Carter et al. (2020): interconnected issues of concern include lack of evidence of clinical benefit, potential automation bias and de-skilling in clinicians, professional autonomy and responsibility, data privacy and protection, protection of patient choice and the ability to contest AI-informed decisions, explainability and interpretability of algorithms, and the potential to increase discrimination and bias. The following is a brief discussion of some of these issues.

One commonly identified problem is a deficiency in policy and legislation around AI use (3, 4). Relatedly, healthcare AI are often developed by commercial entities, but built from public healthcare data, requiring data-sharing arrangements that may not be transparent to or legitimated with the patients who provided those data (4). Governments have in some instances sold or given large volumes of citizens' data to private companies (3) with few guarantees regarding the standard to which the resultant algorithms are held (10), or the benefits that may be returned to citizens.

Without a sufficient governance framework, there are further challenges with liability related to AI. Since these tools are effectively augmenting or even replacing decisions previously made by medical professionals, there are questions surrounding who takes responsibility for erroneous outcomes associated with an algorithm's decisions (4, 6).

Algorithms' reliance on training data also has implications for data quality. Despite persistent claims to the contrary, algorithms are neither objective nor resistant to bias; values and biases inherent in datasets are not automatically ameliorated by AI analyses (3). Since algorithms learn from the datasets with which they are trained, implicit biases within that dataset will be reflected in the resultant algorithms (4, 11). Researchers have argued that algorithms require good and unbiased data to be effective and generalisable (4, 11). Whilst this is true, it is also important to consider the implicit values encoded into any dataset for results to be interpreted appropriately, and to take seriously the challenges of transferring

algorithms between settings (3). Inasmuch as these ethical, legal and social implications are significant for citizens who may receive services involving healthcare AI, the way they are discussed in the public domain is important for public understanding.

Media Framing

To better understand this public domain discussion, we conducted a frame analysis of recent media articles reporting on screening and diagnostic AI. Frame analysis was popularized by Entman (12) as a method for analysing the way journalists represent issues in the media. He suggested that 'frames' are created when information is knowingly or unknowingly emphasised in, or omitted from, texts. According to Entman, frames construct a reality in four dimensions: they define a problem, diagnose causes, deliver moral judgements, and suggest remedies.

The way AI has been portrayed in the media is something that has been investigated in the past (13), but these efforts have typically focused on examining the impact of negative media portrayals of AI on shaping the public's fear and disengagement with AI tools (14, 15). Indeed, this fear and disengagement with AI has also been the subject of research (16).

Studies investigating media framing of AI, however, have discovered that news coverage of AI is more positive than it is negative (14, 15). Likewise, a cursory glance at recent news coverage of Healthcare AI reveals a largely optimistic reporting style (17, 18). As part of a larger project investigating the ethical, legal, and social implications of AI in screening and diagnosis, we were interested in understanding media framing of AI in this context. To our knowledge, this is the first study investigating media framing of any healthcare AI.

Nisbet (19) adapted framing theory to develop a typology of eight frames to categorise science communication in the media. Each frame describes a different way of defining and describing science-related issues. There are eight frames in Nisbet's typology: Social Progress, Economic Development and Competitiveness, Morality and Ethics, Scientific and Technical Uncertainty, Pandora's box/Frankenstein's monster/Runaway science, Public Accountability and Governance, Middle way/Alternative Path, and Conflict and Strategy. A description of these frames can be found below (Table 1). We have utilised this typology in the present study to characterise media framing of Healthcare AI.

Our overall aim was to explore how screening and diagnosis applications of artificial intelligence in healthcare are framed and explored in the media, with a particular emphasis on the extent to which ethical, legal, and social implications were addressed.

Methods

We searched media article databases ProQuest and Factiva on 9 April 2020 with the search terms below (Box 1). We collected all newspaper articles, blog posts, magazine articles, press releases, and presentations dated between 1 April 2019 and 31 March 2020 that addressed artificial intelligence applications in screening and diagnosis.

(" AI " OR "ARTIFICIAL INTELLIGENCE" OR "MACHINE LEARNING") AND ("SCREENING TEST" OR "SCREENING FOR" OR "DIAGNOSIS OF" OR "DIAGNOSING" OR "TEST FOR" OR "TESTING FOR") AND ("HEALTH" OR "HEALTHCARE")

Box 1 - Terms used for media article search

We used constructed week sampling to select a representative random sample of the articles to analyse. As per Luke and colleagues (20) recommendations, we constructed six ‘weeks’ to best account for weekly news cycles. We assigned numbers to each week which fell into the allocated timeframe and used a random number generator to select six random instances of each day of the week. As such, 42 days were selected within the timeframe, comprised of 6 random Mondays, 6 random Tuesdays, 6 random Wednesdays, and so on until Sundays.

We utilised Nisbet’s (19) framing typology as a deductive framework to code media articles. The frames and their definitions are provided in Table 1.

Table 1 - Nisbet's(19) framing typology

Nisbet Frame	Nisbet’s description of this frame[1]
Social Progress	“A means of improving quality of life or solving problems; alternative interpretation as a way to be in harmony with nature instead of mastering it.”
Economic Development	“An economic investment; market benefit or risk; or a point of local, national, or global competitiveness.”
Conflict and Strategy	“A game among elites, such as who is winning or losing the debate; or a battle of personalities or groups (usually a journalist-driven interpretation).”
Morality and Ethics	“A matter of right or wrong; or of respect or disrespect for limits, thresholds, or boundaries.”
Scientific and technical Uncertainty	“A matter of expert understanding or consensus; a debate over what is known versus unknown; or peer-reviewed, confirmed knowledge versus hype or alarmism.”
Pandora’s Box/ Frankenstein’s Monster/ Runaway Science	“A need for precaution or action in face of possible catastrophe and out-of-control consequences; or alternatively as fatalism, where there is no way to avoid the consequences or chosen path”
Public Accountability and Governance	“Research or policy either in the public interest or serving special interests, emphasizing issues of control, transparency, participation, responsiveness, or ownership; or debate over proper use of science and expertise in decision-making (“politicization”).”
Middle Way	“A third way between conflicting or polarized views or options.”

[1] These frames and descriptions are taken directly from Nisbet (19)

Similar deductive approaches have been recommended in other public health media framing research (21). We included additional metrics in the coding framework to collect basic information about the articles' source publications, source countries, date, health condition(s) being addressed, and commercial information about any AI technologies that were being discussed (technology name, company name). We also collected whether benefits and ELSI were mentioned, and a Likert scale metric for the articles impression and tone, similar to the framework developed by O'Keeffe and colleagues (22). Impression was a number between 1 and 5 assigned to characterise the way the article made the coder feel about the technology, whilst tone characterised whether the article was, on balance, negative or positive about the technology. For both Likert scales, 1 was negative, 3 was neutral, and 5 was positive. Our coding instrument is provided in Additional File 1.

To determine inter-rater reliability, the first 38 articles were coded by both authors and results were compared. Discrepancies were resolved before the remaining articles were coded. The inter-rater score was > 85%.

Results

1017 articles were identified by database searching, of which 431 were initially excluded for irrelevancy (Fig. 1). Of the remaining 586, duplicates were removed (n = 219) and then full texts were reviewed for the remaining sample (n = 367).

Of these 367 articles, 56 articles were removed because they did not address the use of AI for screening or diagnosis. A further 63 mentioned AI used for screening or diagnosis in passing but did not discuss it. Typically, this was when articles were discussing AI more broadly, and mentioned a screening technology as an example. Nineteen articles were duplicates that were not identified initially due to having different titles or source names.

Finally, 43 articles were initially coded but later removed from the data after careful discussion since they were word-for-word reports on research abstracts. Typically, they were in sources targeted toward medical audiences, and only discussed study results and rarely their implications for use. Thus, they did not contain anything that could be analysed within a framing typology.

Of the final sample (n = 136), the majority were articles from various news sources (78.7%; n = 107). The remaining 21.3% was comprised of press releases (n = 18), blog posts (n = 9) and magazine articles (n = 2). Across the week days, Wednesday had the highest count of articles (n = 27; 19.9%), although they were distributed relatively evenly across Monday through Friday, with fewer articles published on Saturdays (n = 6) and Sundays (n = 12).

Table 2
Health conditions addressed in each article

HEALTH CONDITION	COUNT	% TOTAL
Cancers (Multiple)	16	11.8%
Cardiovascular Disease	9	6.6%
Colorectal Cancer	8	5.9%
Breast Cancer	7	5.1%
Mental Health	7	5.1%
Alzheimer's Disease	6	4.4%
Lung Cancer	6	4.4%
Diabetic Retinopathy	5	3.7%
Kidney Disease	5	3.7%
Prostate Cancer	4	2.9%
Eye Conditions	3	2.2%
Bowel Cancer	2	1.5%
COVID-19	2	1.5%
Intracranial Haemorrhage	2	1.5%
Neonatal Conditions	2	1.5%
Suicide	2	1.5%
Various	21	15.4%
Other	29	21.3%
TOTAL	136	

Whilst some articles addressed multiple health issues or discussed AI in screening and diagnosis more broadly (n = 21), most of the articles addressed one specific health issue (Table 2). Most commonly this was cancer (n = 51; 37.5%), with some articles discussing multiple types of cancer (n = 16) and others addressing one specific type. Most frequently these were colorectal cancer (n = 8), breast cancer (n = 7), and lung cancer (n = 6).

The benefits of AI in screening and diagnosis were mentioned in 135 of the 136 articles (99.3%) whilst the ethical, legal, and social implications of the technologies were mentioned in only nine of the articles (6.6%). This generally positive perspective on AI in screening and diagnosis is reflected in mean impression and tone scores of 4.67 and 4.68 out of five, respectively.

Table 3
Tally of articles in each frame. Descriptions of frames from Nisbet (19)

Frame	Count	Mean impression /tone	Nisbet Frame	Count (%)
Frame 1 – Social Progress	132 (97.06)	4.77/4.75	Social Progress	132 (97.06)
Frame 2 – Economic Development/ Conflict and Strategy	59 (43.38)	4.88/4.88	Economic Development	59 (43.38)
			Conflict and Strategy	1 (0.74)
Frame 3 – Alternative Perspectives	9 (6.62)	2.44/2.55	Morality and Ethics	4 (2.94)
			Scientific and technical Uncertainty	5 (3.68)
			Pandora’s Box/ Frankenstein’s Monster/ Runaway Science	6 (4.41)
			Public Accountability and Governance	5 (3.68)
			Middle Way	3 (2.21)

This overrepresentation of positively framed articles is also clear in the frame tallies. The Social Progress frame was identified in 97.1% of articles (n = 132) and Economic Development and Competitiveness in 43.4% (n = 59). The remaining frames were only found in fewer than 5% of the sample (Table 3). For the purposes of this analysis, we decided to combine some Nisbet frames because they consistently co-occurred, as shown in Table 1, and described below.

Frame 1 – Social Progress

The social progress frame dominated the rhetoric and was the dominant narrative in the majority of the articles. Broadly, this frame described a necessity to develop strategies for overcoming diseases and ailments, which represent large burdens on the health system and cause preventable death and disease.

In the social progress frame, diseases were problematized, and the authors tended to highlight a disease’s deadliness, its prevalence, or its increasing incidence within a country or worldwide:

“... build a seamless technology that helps providers more accurately detect heart disease, the leading killer in the world” [A82]

“with increasing incidence of cancer cases...” [A105]

Stories in the social progress frame typically implied problems were caused by inefficient current practices in screening and diagnosis which were characterised as “slow” [A21], “subjective” [A10, A27, A195, A244], “challenging” [A244] and “manual” [A5]. It was sometimes reinforced that these inefficient practices were overwhelming doctors and impeding their workflow or damaging their ability to spend time engaging with their patients.

With these issues laid as a foundation, the moral judgement implied in the articles in the social progress frame was that AI in screening and diagnosis was a good and important, or at least an inevitable, solution to address disease morbidity and mortality more effectively. In many of these articles, comment was sought from those with a stake in either developing, researching, or implementing the technology. Quotes were selected which reinforced the salience of the technology and their protagonist status in the article’s narrative.

“We are at a pivotal moment in healthcare history” [A42]

“This is no flash in the pan” [A51]

At surface level, the suggested remedy was the AI screening or diagnosis technology (or in some cases, technologies) that the article was typically reporting on. This was clear in the rhetoric which, in contrast to their description of current screening practices, characterised AI screening and diagnosis tools with a different vocabulary. Whilst current practices were slow, AI was quick; whilst current practices were subjective, AI was objective:

“A key advantage of our technology is that it does not require any additional hardware other than a piece of paper and a software app running on the smartphone.” [A252]

“But having objective, AI-based metrics for detecting AP-ROP is a step in the right direction” [A159]

“We want to have some readout of what’s going on in the brain that is quantitative, objective, and sensitive to subtle changes,” [A45]

More broadly, these technologies were sometimes constructed as being key to a pivotal change in the healthcare system. Sometimes, the importance of quick and easy screening was described in light of a transition within health systems from treatment to prevention [A42], or it was claimed that broader screening will lead to earlier identification of issues and thus better outcomes [A103]. This positioned AI as an important development towards lifting disease burden:

“... informed and strategically directed advanced data mining, supervised machine learning, and robust analytics can be integral, and in fact necessary, for health care providers to detect and anticipate further progression in this disease” [A88; emphasis added]

Frame 2 – Economic Development/Conflict and Strategy

The Economic Development frame was the second most common of Nisbet's frames found in the articles. It overlapped conceptually with the single example of Conflict and Strategy found in the sample and as such, they will be addressed as one. All the articles in this frame coincided with instances of the Social Progress frame, so the arguments are not entirely distinct, with this frame tending to borrow from the strength of the Social Progress narrative. However, the Economic Development/Conflict and Strategy (ED/CS) frame tended to focus more dominantly on monetary rather than human costs, and commercial ventures rather than the diversity of projects reported on in the Social Progress frame. Articles in this frame also were more positive in impression and tone than the sample average (mean impression = 4.88; mean tone = 4.88)

Problem definition and causal attribution were often indistinct from the Social Progress frame with authors first problematizing the impact of a disease (or multiple diseases in rare cases), and attributing the problem to slow, subjective, or inefficient current systems. Sometimes, however, articles in the ED/CS frame additionally discussed the monetary cost of that the disease represents:

"In 2019, AD and other dementias will cost the nation \$290 billion. By 2050, these costs could rise as high as \$1.1 trillion." [A88]

The moral judgements made in the ED/CS frame were more economically focused than that in the Social Progress frame. These articles generally sought comments from individuals with commercial interests in the technologies being reported on, and as in the social progress frame they were afforded protagonist status. In the case of the ED/CS frame, however, the worth and value of these commercial endeavours was often associated with their contribution to economic progress:

"Two Hyderabad-based start-ups ... have come out with promising technological innovations in devising new platforms for delivering effective healthcare services for the public." [A148]

[NAME REMOVED], Chief Executive Officer at [COMPANY NAME REMOVED], [says] 'Our improved methylation-based technology has the potential to address gaps that exist with today's screening options ... Based on these positive data, we plan to advance development of our test toward commercialization.'

The vernacular used in these articles was also often very commercial. Often, algorithms were described as products which were developed to "disrupt" [A74] a "market" [A83, A137]

"We believe that [COMPANY NAME REMOVED]'s ability to apply cutting-edge principles of data science and patient-centered design holds great potential in disrupting the way these cardiovascular patients are monitored, diagnosed, and treated" [A74; emphasis added]

The instance of the Conflict and Strategy perspective, in this case, was an extension of these values into venture capitalism where the article described the company responsible for development of the algorithm as venturing to become "one of the top radiogenomics networks in the United States" [A68].

Implicit in this moral assessment was the argument that capitalist ventures such as these were important for social progress. As such, the suggested remedy in these articles was again very homogenous, with articles tending to document the technologies developed by one individual company, or one company's technology, which was the key to reducing the economic costs associated with a disease. Ergo, technologies tended to be represented as economic solutions to largely economic problems.

"By offering a method to track progression using only a mobile phone or tablet ... the company aims to stem the cost of monitoring and screening for Alzheimer's and related dementias in an aging population."
[A18; emphasis added]

Frame 3 – Alternative Perspectives

Each of the Morality, Pandora's Box, Scientific Uncertainty, Middle Way, and Governance frames from the Nisbet typology were present in some articles. However, they were indistinct from one another as they tended to be present, together, in articles that adopted a more neutral stance compared to the sample average (mean impression 2.44; tone 2.45). As such, we have dubbed the conglomeration of these frames, 'Alternative Perspectives'. Nine total articles fit into the alternative perspectives frame, and generally more than one of Nisbet's 5 initial frames which comprised the alternative perspectives frame were represented in each article (median 2; max 5; avg 2.27). This Alternative Perspectives frame overlapped entirely with articles which discussed ELSIs. That is, the nine articles coded into this frame are the same nine which discuss ELSIs of healthcare AI. Despite being relatively heterogenous within themselves, the articles which fell into Frame 3 were distinct in content and tone from the rest of the sample.

Five of the nine articles also coincided with occurrences of the Social Progress frame so in many of these articles the Social Progress narrative was also present and, in some cases, dominant. As such, problem definition often, like the other articles in this sample, involved the problematization of diseases and their impact. However, AI tools were also problematized in these articles as potentially risky. Many articles in this frame began by emphasising AI's benefits, and then went on to offer a caveat:

"Of course, AI applications in sectors like healthcare can yield major social benefits. However, the potential for the mishandling or manipulation of data collected by governments and companies to enable these applications creates risks far greater than those associated with past data-privacy scandals" [A3]

As reflected in their sentiment scores, these articles were not entirely comprised of negative perspectives on AI in screening and diagnosis. The authors were instead presenting the narrative as a balanced appraisal of AI's harms and benefits. Thus, stories implied that the issues related to AI were caused by the harmful capitalistic values of those developing AI tools (Morality), the AI field's lack of involvement with traditional medical research (Scientific Uncertainty), or the poor legislation surrounding AI that has let it develop unbridled (Governance), rather than the AI technologies themselves.

"But the reason [RESEARCHER'S NAME REMOVED] hadn't heard of it is because the company hasn't shared information about the tool with researchers such as him, or with the broader medical and

scientific community. Without that information, [RESEARCHER'S NAME REMOVED] said, big questions about [TECH COMPANY'S NAME REMOVED] suicide-monitoring tool are impossible to answer." [A91]

"the values of AI designers or the purchasing administrators are not necessarily the values of the bedside clinician or patient. Those value collisions and tensions are going to be sites of significant ethical conflict" [A22]

"it's important to remain cautious of these kind of claims, as AI can contain faults based on how it's trained and designed" [A143]

The moral judgement made in these articles was that a more careful approach was needed, to harness the important social developments associated with AI but to simultaneously implement more controls so the issues and value conflicts were better managed. Often, in contrast to the other articles in this sample, these authors would seek out field experts who were not involved with the development of the AI tool(s) in question, giving their argument greater credence through impartiality.

"However, [DOCTOR'S NAME REMOVED] from Hanoi Medical University Hospital expressed concern that ultrasound is not an accurate method to diagnose liver cancer" [A260]

"We as the public are partaking in this grand experiment, but we don't know if it's useful or not," [RESEARCHER'S NAME REMOVED] told Business Insider ... It is the latest example of a trend in Silicon Valley, where the barriers that separate tech from healthcare are crumbling" [A91]

Typically, the solution presented by these articles was for a more regulated and cautious approach to AI in screening and diagnosis. Doctors and those in AI development were implored to be 'ethical' [A93] and it was proposed that only 'explainable' [A143; A22] or 'auditable' [A22] algorithms should be implemented.

Discussion

Our frame analysis found that media representations of AI in screening and diagnosis were overwhelmingly positive. Benefits were mentioned in all but one article, whilst the ethical, legal, and social implications were much less frequently mentioned in only nine articles. Articles typically fit dominantly within the social progress frame, where AI tools were poised as solutions to constrain rampant disease and morbidity; this was sometimes combined with an economic frame that emphasized financial benefit.

Alternative perspectives existed in a small minority of articles. These articles stood out from the rest despite their heterogeneity for presenting a more negative perspective and branching across the remaining Nisbet frames. There was nothing that stood out about the sources of these articles, which were similarly diverse to the rest of the sample. The ELSI arguments mentioned in these articles were relatively thin; there were implications of inappropriately market-driven motivations (and a broader recognition of the potential for value conflict around AI), as well as concern regarding evidence of benefit (beneficence) and the need for explainability (which by implication relates both to the value of

transparency and the preservation of professional autonomy and responsibility). However, none of these important issues were dealt with in any depth in this sample.

Like existing research on media framing of AI more broadly (14, 15), we found that media representations of AI in screening and diagnosis were predominantly positive. Our own sample, however, was much more positively framed than that of research looking at media representations of AI more broadly. For example, Chuan and colleagues (14) found that 47.6% of their sample of articles covered at least one type of risk, whilst we found ELSIs (including risk of harm) were mentioned in only 6.6% of our sample.

This points to an apparent discrepancy between media perspectives on AI in screening and diagnosis, and media perspectives on AI more broadly. Healthcare applications for AI are perhaps more easily spun into narratives which emphasise social and personal benefit, and present less obvious harms to the public than, for example, self-driving cars or autonomous weapons. Indeed, Cave and colleagues (16), who presented a series of positive and negative narratives about the future of AI to research participants, reported that the ‘immortality’ narrative, where AI revolutionises medicine and treatment, was one of only two of eight which elicited more excitement than anxiety from participants. This suggests a general appetite for good news stories about medical AI, and may help drive the patterns in reporting that we found.

It is important that these positive narratives do not overshadow meaningful discussion about the ELSIs associated with AI in screening and diagnosis. The optimistic and often economically driven argument for implementation of AI in healthcare is cause for concern if it is allowed to dominate the media and prevent discussion about how to develop more ethical healthcare AI.

Conclusion

Our study was the first to examine media perspectives on AI in screening and diagnosis. Results show that perceptions of screening and diagnosis AI in the media are predominantly positive—far more so than reporting on AI more generally—with few articles adopting neutral or negative stances toward the technologies. We suggest that healthcare AI may be subject to a more positive media reception than AI in general, and that very few articles discussed the ethical, legal, and social implications of AI in screening and diagnosis. This represents an opportunity, especially for specialist health journalists, to provide publics with deeper analysis of the ethical, legal and social implications of screening and diagnostic AI, and to do so now before these technologies become firmly embedded in everyday healthcare delivery.

Abbreviations

AI
Artificial Intelligence
ELSIs
Ethical, Legal and Social Implications

Declarations

Availability of data and materials

The dataset supporting the conclusions of this article is included within the article and its additional files.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

SC conceived of the presented idea. Both authors developed and designed the data collection tool. EF collected and analysed the data; SC co-coded a subset. EF led authorship of the manuscript with contribution from SC.

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References

1. Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. *Future Healthc J.* 2019 Jun;6(2):94–8.
2. Walsh T, Levy N, Bell G, Elliott A, Maclaurin J, Mareels I, et al. The effective and ethical development of artificial intelligence: an opportunity to improve our wellbeing. *The Australian Council of Learned Academies*; 2019.
3. Carter SM, Rogers W, Win KT, Frazer H, Richards B, Houssami N. The ethical, legal and social implications of using artificial intelligence systems in breast cancer care. *The Breast.* 2020 Feb;49:25–32.
4. Dorado-Díaz PI, Sampedro-Gómez J, Vicente-Palacios V, Sánchez PL. Applications of Artificial Intelligence in Cardiology. *The Future is Already Here. Revista Española de Cardiología (English Edition).* 2019 Dec 1;72(12):1065–75.
5. Emanuel EJ, Wachter RM. Artificial Intelligence in Health Care: Will the Value Match the Hype? *JAMA.* 2019 Jun 18;321(23):2281–2.

6. Loh E. Medicine and the rise of the robots: a qualitative review of recent advances of artificial intelligence in health. *leader*. 2018 Jun;2(2):59–63.
7. Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. *Nat Rev Cancer*. 2018 Aug;18(8):500–10.
8. Houssami N, Kirkpatrick-Jones G, Noguchi N, Lee CI. Artificial Intelligence (AI) for the early detection of breast cancer: a scoping review to assess AI's potential in breast screening practice. *Expert Review of Medical Devices*. 2019 May 4;16(5):351–62.
9. Lopez-Jimenez F, Attia Z, Arruda-Olson AM, Carter R, Chareonthaitawee P, Jouni H, et al. Artificial Intelligence in Cardiology: Present and Future. *Mayo Clinic Proceedings*. 2020 May 1;95(5):1015–39.
10. Vollmer S, Mateen BA, Bohner G, Király FJ, Ghani R, Jonsson P, et al. Machine learning and artificial intelligence research for patient benefit: 20 critical questions on transparency, replicability, ethics, and effectiveness. *BMJ [Internet]*. 2020 Mar 20 [cited 2020 Mar 29];368. Available from: <https://www.bmj.com/content/368/bmj.l6927>.
11. Verghese A, Shah NH, Harrington RA. What This Computer Needs Is a Physician: Humanism and Artificial Intelligence. *JAMA*. 2018 Jan 2;319(1):19–20.
12. Entman RM. Framing. Toward Clarification of a Fractured Paradigm. *Journal of Communication*. 1993 Dec 1;43(4):51–8.
13. Cave S, Craig C, Dihal K, Dillon S, Montgomery J, Singler B, et al. Portrayals and perceptions of AI and why they matter [Internet]. The Royal Society; 2018 Dec [cited 2020 May 7]. Available from: <https://www.repository.cam.ac.uk/handle/1810/287193>.
14. <https://dl.acm.org/doi/10.1145/3306618.3314285>
Chuan C-H, Tsai W-HS, Cho SY. Framing Artificial Intelligence in American Newspapers. In: *Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society [Internet]*. Honolulu HI USA: ACM; 2019 [cited 2020 Jun 27]. p. 339–44. Available from: <https://dl.acm.org/doi/10.1145/3306618.3314285>.
15. Sentiment Analysis of the News Media on Artificial Intelligence Does Not Support Claims of Negative Bias Against Artificial Intelligence
10.1089/omi.2019.0078
Garvey C, Maskal C. Sentiment Analysis of the News Media on Artificial Intelligence Does Not Support Claims of Negative Bias Against Artificial Intelligence. *OMICS: A Journal of Integrative Biology [Internet]*. 2019 Jul 16 [cited 2020 Mar 31]; Available from: <https://www.liebertpub.com/doi/full/10.1089/omi.2019.0078>.
16. 10.1145/3306618.3314232
Cave S, Coughlan K, Dihal K. “Scary Robots”: Examining Public Responses to AI. In: *Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society [Internet]*. Honolulu, HI, USA: Association for Computing Machinery; 2019 [cited 2020 May 6]. p. 331–337. (AIES '19). Available from: <https://doi.org/10.1145/3306618.3314232>.

17. Service, Robots. Artificial Intelligence Gaining Steam in Healthcare.
<https://hitinfrastructure.com/news/service-robots-artificial-intelligence-gaining-steam-in-healthcare> 2020 accessed Jun 27, 2020.
18. Roundup. GE Healthcare launches AI suite to detect COVID-19 abnormalities, Health Help Now app to close and more briefs. Healthcare IT News.
<https://www.healthcareitnews.com/news/europe/roundup-ge-healthcare-launches-ai-suite-detect-covid-19-abnormalities-health-help-now> accessed Jun 27 2020.
19. Nisbet MC. Communicating Climate Change: Why Frames Matter for Public Engagement. *Environment: Science and Policy for Sustainable Development*. 2009 Mar;51(2):12–23.
20. Luke DA, Caburnay CA, Cohen EL. How Much Is Enough? New Recommendations for Using Constructed Week Sampling in Newspaper Content Analysis of Health Stories. *Communication Methods Measures*. 2011 Mar;2(1):76–91. 5(.
21. Foley K, Ward P, McNaughton D. Innovating Qualitative Framing Analysis for Purposes of Media Analysis Within Public Health Inquiry. *Qual Health Res*. 2019 Oct 1;29(12):1810–22.
22. O’Keeffe M, Barratt A, Maher C, Zadro J, Fabbri A, Jones M, et al. Media Coverage of the Benefits and Harms of Testing the Healthy: a protocol for a descriptive study. *BMJ Open*. 2019 Aug;9(8):e029532.

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