PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance? A Cross-Sectional National Survey and Regression Analysis Using an Instrumental Variable
AUTHORS	Zaresani, Arezou; Scott, Anthony

VERSION 1 – REVIEW

REVIEWER	Tuulikki Vehko Finnish institute for health and welfare (THL) , Finland
REVIEW RETURNED	29-Jun-2020

GENERAL COMMENTS	Thank you for the opportunity to review the important aim related to digital technologies and physicians' job satisfaction and work-life balance. ("Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance?) COMMENT 1. The context of the study need information about Australian health care system The Australian government page (https://www.health.gov.au/about-us/the-australian-health-system) underline that digital technologies can affect the health workforce including the gate keeping professionals namely GPs. However, it is not easy to find information to describe the context of the study. Please add a paragraph in the introduction describing the Australian health care system Firstly, please describe the recent years trend in the use of digital health technology among physicians in Australia. Secondly, the paragraph should describe the primary care including the information whether the GP works in a solo practice or in a group based practice (eg. health care center) with various health care professionals including nurses and physiotherapist. Thirdly, add background information about "who" buy the digital health technology to the GP practice and what kind of acquisition methods are used. Please add some background information also about the acquisition methods related to digital technologies in the hospital setting too. In the discussion section please explain whether there are any economic or knowledge-related factors that influence the acquisition of digital technologies and thus their use or non-use in different levels of health care (GP / hospital). COMMENT 2. The study population - Should it be more strictly limited? Another issue I suggest to be discussed related to respondents who were not currently working (apparently the question "3. Which of the following statements describe your current situation?") What did they answer when asked work related issues ? (eg. 39. In your last usual

	week at work, Did you use digital health technologies / solutions for the following activities?/ Job satisfaction / Work-life balance) The last result of the list is obvious (" Physicians who used digital health technology were older, more likely to be male, more likely to have a live-in partner, who is also more likely to be employed.") . I suggest that those who do not participate in patient work ("not employed group") be excluded from the group of respondents. Clarify why these respondents are left in the study population and what added value does it bring to the results?

REVIEWER	Prem Prakash Jayaraman Swinburne University of Technology
REVIEW RETURNED	22-Sep-2020

GENERAL COMMENTS	The paper addresses a very important topic especially the current situation where the importance of DHT is more prevalent than ever before. The statistical analysis conducted by the authors makes sense and is backed by sufficient data to arrive the significant conclusions highlighted in the paper. I have the following comments that I feel would further help improve the paper. It will be good to specify in the setting and results section (introduction part) the specific DHT's that were considered in this study (mostly around EMR kinds of usage). This is good as DHT covers a very large space which may lead to misinterpretation of the results to the readers. Page 4 – Line 38-39 It may be good to elaborate further on what this mixed evidence outcomes were to further strengthen the need for this paper while also using that as an evidence of the gap that other papers have not covered 2.2 Source of Data It is not clear from this section if the team contributed in the development of the survey questions on the use of Digital Health Technology. If this is the case, it will be good to highlight this here more clearly. It will be good to provide how the choice of 4 questions in the survey on Digital Health evaluation (the foundations of this paper) was guided/developed? I understand the paper currently cities other prior published work. However, to make the paper more complete, such a precursory introduction/discussion will be beneficial. Furthermore, without this discussion, it also makes the paper's contribution limited – more a statistical analysis of the data collected. In the discussion, it would have been good to discuss further about the limitation of current studies including methods used to arrive at their results and how the work presented in the paper is significantly advancing this knowledge. It will be good to throw some light on the non-uptake of digital health technologies factors as well by physicians under 40 (as from the statistic it is apparent that most of them don't believe in the technology). If this is the case, it will be interesting to observe how the transition happens over to using DHT at a later stage. Was the organisational influence included in any of these studies? Depending on the kind of practice, some of them may need to use DHT (which could also lead them to start to experience the benefits). Was this explored and if not why?

	Finally, some strong justification for the choice of probit model for such analysis is currently lacking in the paper. Why authors did not consider another alternative approach such as logistic regression?

VERSION 1 – AUTHOR RESPONSE

Dear Dr. Tuulikki Vehko,

My co-author Professor Anthony Scott and I would like to thank you for your feedback on our manuscript entitled “Does Digital Health Technology Improve Physicians’ Job Satisfaction and Work-life Balance?” (Manuscript ID bmjopen-2020-041690). We appreciate your overall positive feedback on our manuscript. We have made a great effort to address all of your comments. The rest of this letter provides responses summarizing how our revisions dealt with your comments (*black italicized*).

A. *The context of the study need information about Australian health care system.*

1. *The Australian government page (https://www.health.gov.au/about-us/the-australian-health-system) underline that digital technologies can affect the health workforce including the gate keeping professionals namely GPs. However, it is not easy to find information to describe the context of the study. Please add a paragraph in the introduction describing the Australian health care system.*

    a. *Firstly, please describe the recent years trend in the use of digital health technology among physicians in Australia.*

    b. *Secondly, the paragraph should describe the primary care including the information whether the GP works in a solo practice or in a group based practice (e.g., health care center) with various health care professionals including nurses and physiotherapist.*

    c. *Thirdly, add background information about ”who” buy the digital health technology to the GP practice and what kind of acquisition methods are used. Please add some background information also about the acquisition methods related to digital technologies in the hospital setting too.*

We included a new section (section 1.1 on P. 6) in the introduction section that briefly describes the Australian healthcare system and these broad issues around the use of digital health technologies. For your convenience, the new section is provided below:

1.1 Australian healthcare system (P. 6)

Medicare is Australia's universal health care system funded through taxation. Medicare funds all medical services provided by private medical practitioners (general practitioners and other specialists) outside of hospitals by providing subsidies to patients for each service, including consultations and procedures. Patients are charged using a fee-for-service scheme. Medicare also provides around half of the funding to public hospitals, with the rest provided by States and Territories who own and manage public hospitals. The Federal Government also provides subsidies for private health insurance, with 43% of the population holding private health insurance, and around half of all hospitals are privately owned.

My Health Record, the Australian national electronic shared health record was introduced in 2019 where all Australians have a record unless they opt out. The use of My Health Record by patients and health care providers is voluntary. They also continue to use their own systems, such that there remains variation in general use by physicians and how digital health technology are used.

Historically, general practitioners, who are organized in small group practices with around 5% working in solo practices, have been responsible for procuring their own IT systems supported by government funding delivered through the Practice Incentive Program since 1998. The majority of general practitioners practices are computerized, but with variation in use, including storage of electronic health records. Other specialists can work in public and/or private hospitals and also in their own private offices. Public hospitals are run by each State and Territory Government and have some autonomy, which varies across States and Territories, to procure their own IT systems, again with government funding, but leading to considerable variation in the systems used and how they are used with little interoperability between hospitals and between hospitals and primary care.

2. *In the discussion section please explain whether there are any economic or knowledge-related factors that influence the acquisition of digital technologies and thus their use or non-use in different levels of health care (GP / hospital).*

We included a new paragraph in the discussion section (Section 4 in P.19) stating that issues concerned with acquisition and procurement of IT systems were not the focus of this study, and that further research needs to be conducted in this area. For your convenience, the new paragraph is provided below:

Discussion (P. 19)

Another limitation of this study was that this research did not directly examine the acquisition and procurement of IT systems by healthcare providers, in which a range of factors will play a role that were not included in the analysis, including the mix of public and private funding for different types of healthcare providers. General practitioners receive subsidies from governments, while public hospitals conduct their own procurement with government oversight and funding, and private hospitals operate in the private market. A better understating of these factors would help the more efficient design of policies to increase the use of digital health technology and improve the flow of the healthcare system. This is also related to the separation of the effects from the organizational level, where organizational decisions determine the use rather than individual preferences. The results show that those in only public or only private settings were more likely to use digital health technology than those who worked across both sectors.

B. *The study population - Should it be more strictly limited?*

1. *Another issue I suggest to be discussed related to respondents who were not currently working (apparently the question "3. Which of the following statements describe your current situation?") What did they answer when asked work related issues? (e.g., 39. In your last usual week at work, Did you use digital health technologies / solutions for the following activities?/ Job satisfaction / Work-life balance). The last result of the list is obvious ("Physicians who used digital health technology were older, more likely to be male, more likely to have a live-in partner, who is also more likely to be employed."). I suggest that those who do not participate in patient work ("not employed group") be excluded from the group of respondents. Clarify why these respondents are left in the study population and what added value does it bring to the results?*

   The analysis already excludes physiciaans who are not working in clinical practice. These doctors would only fill out Q3 in the survey and are instructed not to proceed to answer any other questions. We have clarified in the method and abstract and at the beginning of the results section that the sample included doctors working in clinical practice.

Dear Dr. Prem Prakash Jayaraman,

My co-author Professor Anthony Scott and I would like to thank you for your feedback on our manuscript entitled “Does Digital Health Technology Improve Physicians’ Job Satisfaction and Work-life Balance?” (Manuscript ID bmjopen-2020-041690). We appreciate your overall positive feedback on our manuscript. We have made a great effort to address your comments. The rest of this letter provides responses summarizing how our revisions dealt with your comments (*black italicized*).

The paper addresses a very important topic especially the current situation where the importance of DHT is more prevalent than ever before. The statistical analysis conducted by the authors makes sense and is backed by sufficient data to arrive the significant conclusions highlighted in the paper. I have the following comments that I feel would further help improve the paper.

1. *It will be good to specify in the setting and results section (introduction part) the specific DHT’s that were considered in this study (mostly around EMR kinds of usage).*

   This is good as DHT covers a very large space which may lead to misinterpretation of the results to the readers.

   Thanks for pointing this out. To clarify the specific digital health technology considered in this paper, we added Table 1 (P. 6) and Figure 1 (P. 13). For your convenience, we included the new table and figure presented below.

Table 1: Activities physicians use digital health technology

Sending/Receiving referrals from other health practitioners
Viewing pathology or diagnostic imaging results
~~Viewing pathology or diagnostic imaging results~~
~~Ordering pathology tests or diagnostic imaging~~
Storing advanced care planning documents
Completing/viewing event summaries (e.g. discharge summaries/specialist reports)
Writing prescriptions

Viewing medicines information

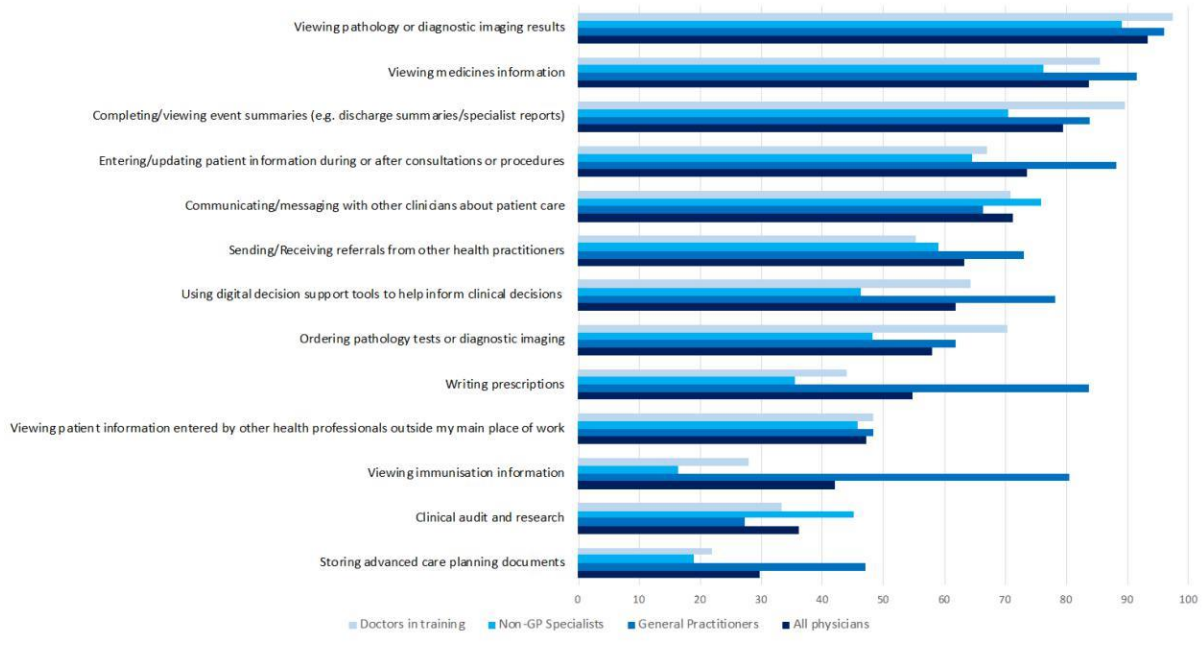
Viewing immunisation information

Viewing patient information entered by other health professionals outside my main place of work

Entering/updating patient information during or after consultations or procedures Clinical audit and research

Using digital decision support tools to help inform clinical decisions (e.g. clinical dashboards; automated alerts, warnings and reminders; algorithms; electronic clinical guidelines and pathways)

Figure 1: Use of digital health technology among Australian physicians



Note: This figure shows the activities for which physicians use digital health technology, broken down by physician type. The figure uses a question in the 11th wave of The Medicine in Australia: Balancing Employment and Life (MABEL) survey data, asking physicians, “In your last usual week at work, did you use digital health technologies/solutions for the following activities?” The figure presents the percent of physicians answered, “Yes.

2. *Page 4 – Line 38-39*

   It may be good to elaborate further on what this mixed evidence outcomes were to further strengthen the need for this paper while also using that as an evidence of the gap that other papers have not covered.

   Thanks for pointing this out. We updated the mentioned paragraph (P. 5) as below:

   Physicians’ use of digital health technology is determined by a range of factors that have been summarised in previous literature reviews and qualitative research. Previous systematic reviews on the impact of using digital health technology on time use,4 health outcomes, patient satisfaction, and processes of patient care are not conclusive. A systematic review examining the effects on quality of care showed positive effects on documentation time, guideline adherence, medication errors, and adverse drug events. Findings on the effects of using digital health technology in hospital settings also are not conclusive.9 In ambulatory and primary care, a recent survey showed an association between the use of electronic medical records and physicians’ burnout and stress, but that other working conditions mattered more. Previous research in Australia found that general practitioners who agreed that IT was useful were more likely to experience higher work-life balance.

3. *2.2 Source of Data*

   It is not clear from this section if the team contributed in the development of the survey questions on the use of Digital Health Technology. If this is the case, it will be good to highlight this here more clearly.

   To improve clarity, we included additional text outlining how the questions were developed in Section 2.3.1 (P.8). For your convenience, the mentioned sections are provided below.

   2.3.1 Digital health technology (P. 8)

   The 11th wave of the survey included new questions on the use of digital health technology. These questions were developed based on previous systematic literature reviews, selective interviews with a small number of physicians, and previous research conducted by the Australian Department of Health and the Australian Digital Health Agency. The questions were pre-tested in a pilot survey with several changes made to

the main survey questions. The questions were designed to be the same across the many contexts, work settings, and specialties in which physicians work. The questions on use were focused on whether or not respondents had used digital health technology for a pre-specified range of activities. In the analysis, the use of digital health technology was measured as a binary variable equal to one for physicians who reported using it for at least one of the activities in Table 1.

The survey also asked physicians about their attitudes and beliefs around digital health technology. The questions covered four main areas of attitudes and beliefs that were hypothesized to influence the use: peer effects, effectiveness of digital health technology, data sharing and privacy concerns, and availability of IT support. The most generally posed questions were used to construct binary variables which were defined equal to one if respondents “agreed” or “strongly agreed” with the statements: “Digital health technology improve care processes (e.g., improve care coordination, continuity of care, reduce duplication),” and “Colleagues and support staff already extensively use digital health technology,” and “I receive support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, back-ups),” and “I have no concerns about data privacy or security.“

4. *It will be good to provide how the choice of 4 questions in the survey on Digital Health evaluation (the foundations of this paper) was guided/developed? I understand the paper currently cities other prior published work. However, to make the paper more complete, such a precursory introduction/discussion will be beneficial. Furthermore, without this discussion, it also makes the paper’s contribution limited – more a statistical analysis of the data collected.*

We moved the paragraph describing these questions to Section 2.3.1 (P. 9) on the digital health technology questions, in addition to inserting additional text in the paragraph on how the questions were developed (see also a response to the previous comment). For your convenience, the mentioned sections are provided below.

2.3.1 Digital health technology (p. 9)

The survey also asked physicians about their attitudes and beliefs around digital health technology. The questions covered four main areas of attitudes and beliefs that were hypothesized to influence the use: peer effects, effectiveness of digital health technology, data sharing and privacy concerns, and availability of IT support. The most generally posed questions were used to construct binary variables which were defined equal to one if respondents “agreed” or “strongly agreed” with the statements: “Digital health technology improve care processes (e.g., improve care coordination, continuity of care, reduce duplication),” and “Colleagues and support staff already extensively use digital health technology,” and “I receive support and advice on IT

security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, back-ups)," and "I have no concerns about data privacy or security."

5. *In the discussion, it would have been good to discuss further about the limitation of current studies including methods used to arrive at their results and how the work presented in the paper is significantly advancing this knowledge.*

Thanks for this comment. We updated the second paragraph of the discussion section and added two additional paragraphs, further discussing the study's limitations. The revised paragraph and the two new paragraphs are provided below for your convenience.

4. Discussion (P. 18)

Previous research on the effects of using digital health technology on various aspects of physicians' work is not conclusive. While some studies show that using digital health technology benefits some aspects of physicians' work, other studies show that it does not or provide inconclusive results. This could be due to either the statistical method or the data used in these studies. Our study is the first to examine the association between using digital health technology with physicians' job satisfaction and building on a previous study examining the associations with the work-life balance. We used MABEL data, which is representative of the physician population in Australia. The data included a rich set of information on the physicians, including their personality traits. Further, we used an instrumental variable model to correct for the biases due to reverse causality and confounding factors. The results of this study suggested that digital health technology served more as a work resource for physicians rather than a work demand.

A limitation of this study was that the results were based on a cross-sectional survey. Although all the models were adjusted for a rich set of control variables, including physicians' personality traits, and an instrumental variable was used to adjust for the bias, there still could be other unobserved factors that were not controlled for, requiring a cautious interpretation of the findings.

Another limitation of this study was that this research did not directly examine the acquisition and procurement of IT systems by healthcare providers, in which a range of factors will play a role that were not included in the analysis, including the mix of public and private funding for different types of healthcare providers. General practitioners receive subsidies from governments, while public hospitals conduct their own procurement with government oversight and funding, and private hospitals operate in the private market. A better understating of these factors would help the more efficient design of policies to increase the use of digital health technology and improve the flow of the healthcare system. This is also related to the separation of the effects from the organizational level, where organizational decisions determine

the use rather than individual preferences. The results show that those in only public or only private settings were more likely to use digital health technology than those who worked across both sectors.

This study provided new relevant evidence on the association between the use of digital health technology and physicians' job satisfaction and work-life balance. Educational programs for physicians to encourage the use should focus on persuading them of the benefits of using digital health technology, colleagues' use, and ensuring sufficient IT support.

6. *It will be good to throw some light on the non-uptake of digital health technologies factors as well by physicians under 40 (as from the statistic it is apparent that most of them don't believe in the technology). If this is the case, it will be interesting to observe how the transition happens over to using DHT at a later stage.*

Thanks for pointing out the factors associated with not using digital health technologies. The summary statistic (Table 2 in P. 14) shows that, on average, physicians who do not use digital health technologies are younger than those who use it (43.9 versus 47.1 years). This is also shown in Table A.3 in the Appendix and persists after other covariates are controlled for. Use increases with age, except for those over 60 years old. We agree that it would be interesting to see how the transition to use happens as the physicians get older. However, this analysis requires longitudinal data on physicians, and our cross-section data does not allow us to perform such analysis.

7. *Was the organizational influence included in any of these studies? Depending on the kind of practice, some of them may need to use DHT (which could also lead them to start to experience the benefits). Was this explored and if not why?*

In all of our regression analysis, we include variables related to whether the doctor worked in public, private, or both types of setting (see Table 1 in the paper at P. 13). The detailed estimation results are provided in Table A.1, A.2, and A.3 in the Appendix. The estimated effects on the uptake of digital health technology, presented in Table A.3, show that compared to doctors who worked in both public and private settings, those who worked only in public settings or only in private settings were respectively 3.0 and 2.1 percentage points more likely to use DHT.

However, we are not able to control for organizational fixed effects or cluster to separately identify the role of the organization rather the individual effects since our data is not a panel and is a cross-section. We included this as a limitation of our study in the discussion section (P. 19), as below:

4. Discussion (P. 19)

Another limitation of this study was that this research did not directly examine the acquisition and procurement of IT systems by healthcare providers, in which a range of factors will play a role that were not included in the analysis, including the mix of public and private funding for different types of healthcare providers. General practitioners receive subsidies from governments, while public hospitals conduct their own procurement with government oversight and funding, and private hospitals operate in the private market. A better understating of these factors would help the more efficient design of policies to increase the use of digital health technology and improve the flow of the healthcare system. This is also related to the separation of the effects from the organizational level, where organizational decisions determine the use rather than individual preferences. The results show that those in only public or only private settings were more likely to use digital health technology than those who worked across both sectors.

8. *Finally, some strong justification for the choice of probit model for such analysis is currently lacking in the paper. Why authors did not consider another alternative approach such as logistic regression?*

Our outcome variables (use of digital health technology, job satisfaction, and work-life balance) are binary, and potentially we could use both probit and logistic models. But for practical reasons, we decided to use probit models. This is because the instrumental variable estimator in the STATA program (the most commonly used program for statistical analysis by economists) is only available with probit. Furthermore, the results can be interpreted more easily as changes in proportions/percentage points. Results using logistic regression are very similar.

VERSION 2 – REVIEW

REVIEWER	Tuulikki Vehko Finnish institute for health and welfare, Finland
REVIEW RETURNED	22-Oct-2020

GENERAL COMMENTS	Thank you for the opportunity to review manuscript "Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance? A Cross-Sectional National Survey and Regression Analysis Using an Instrumental Variable". The authors have now added the information about the context related to the Australian health care system, provided more detailed information related to the questionnaire and made requested exclusions to the study population. Please correct one small typo on page 16 line 49 "Th probability" -> The probability I recommend the article for publication.

REVIEWER	Prem Prakash Jayaraman Swinburne university of technology

REVIEW RETURNED	13-Nov-2020

GENERAL COMMENTS	I would like to thanks the authors for making changes to the paper based on my suggestions/comments. I am satisfied with the changes made by the authors.