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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-041690
Article Type:	Original research
Date Submitted by the Author:	15-Jun-2020
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Keywords:	Information management < BIOTECHNOLOGY & BIOINFORMATICS, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance?

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Abstract

Objectives

Digital Health Technology (DHT) are essential for improving the flow and quality of information shared between health care providers, which can, in turn, improve care processes and reduce costs. However, DHT can be viewed as an additional work demand and source of stress and burnout. This study examined the association between using DHT by physicians and their job satisfaction and work-life balance.

Setting

Probit models was used to examine association between using DHT and probability of reporting high job satisfaction and a good work-life balance. The models included a rich set of controls including physicians' personality traits, and Instrumental Variable (IV) was used to control for unobservable confounders and reverse causality.

Participants

We conducted a retrospective cohort study involving 8,878 physicians in Australia.

Primary and secondary outcome measures

Uptake of digital health technology by physicians and their job satisfaction and work-life balance.

Results

Physicians with positive beliefs about the effectiveness of DHT were 3.8 Percentage Points (PP) more likely to use DHT compared with those who did not. Physicians with colleagues who already used DHT were also 4.1 PP more likely to use DHT. The availability of IT support and lack of privacy concerns increased probability of using DHT by 1.6 and 0.5 PP. Physicians who used DHT were 16.2 and 23.2 PP more likely to report respectively higher job satisfaction and good work-life balance, compared with the physicians who did not use it. The estimates using IV were slightly smaller at 14.2 and 20.3 PP for reporting higher job satisfaction and good work-life balance.

Conclusions

Findings suggested DHT served more as work resource than work demand for physicians who used it.

Article Summary

Strength and limitations

- This study conducted a retrospective cohort study involving 8,878 physicians in Australia to examine the association between using digital health technology by physicians and their job satisfaction and work-life balance using probit and instrumental variable analysis.
- The results suggested that digital health technology served more as a work resource rather than work demand for the physicians who used it and was associated with improvements in their job satisfaction and work-life balance.
- A limitation of this study was that the results were based on a cross-sectional survey. 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 biased due to

reverse causality issue and confounding factors. There still could be other unobserved factors that were not controlled for, requiring a cautious interpretation of the findings.

Conflict of interest statement

The two authors have no conflict of interest to declare. This study is not previously published and is not currently under review elsewhere.

Data sharing statement

No additional data available.

Funding statement

This research was funded by the Australian Digital Health Agency. We used data from the Medicine in Australia: Balancing Employment and Life (MABEL) longitudinal survey. Funding for MABEL was provided by the National Health and Medical Research Council (2007–2016: 454799 and 1019605); the Australian Government Department of Health and Ageing (2008); Health Workforce Australia (2013); and in 2017 The University of Melbourne, Medibank Better Health Foundation, New South Wales Department of Health, and Victorian Department of Health and Human Services. In 2018, MABEL was funded by the Australian Government Department of Health, Victorian Department of Health and Human Services, and Australian Digital Health Agency. The study was approved by The University of Melbourne Faculty of Business and Economics Human Ethics Advisory Group (Ref: 0709559) and the Monash University Standing Committee on Ethics in Research Involving Humans (Ref: CF07/1102–2007000291).

Keywords: digital health technology; electronic health records; job satisfaction; work-life balance.

Word count: 2,630.

1 Introduction

Digital health technology, such as shared electronic health records, can improve the flow of information between different healthcare providers and between providers and patients. Convincing busy physicians to use digital health technology in their practice requires not only evidence on the benefits to patients, but also evidence on the benefits and costs to the physicians themselves. There is a potential for digital health technology to save physicians' time by accessing patients' medical records, test results, and medication information more quickly. Through sharing more standard information and making such information available at the point of care, digital health technology can reduce duplication of tests, reduce medication errors, and improve patient safety. However, digital health technology can also be an additional work demand as extra time is needed to input patients' health information into the electronic record and to read and interpret the information uploaded by the other healthcare providers. The net impact of these positive and negative factors influences whether physicians choose to use digital health technology.

The use of digital health technology by physicians is determined by a range of factors that have been summarised in previous literature reviews and qualitative research.[1–3] Previous systematic reviews on the impact on time use,[4] health outcomes, patient satisfaction, and processes of patient care[5–7] provide mixed evidence. A systematic review examining the effects on quality of care showed positive effects on documentation time, guideline adherence, medication errors, and adverse drug events.[8] A more recent review in hospital settings provided mixed evidence.[9] In ambulatory and primary care, a recent survey showed that there was an association with the use of electronic medical records and burnout and stress, but that other working conditions mattered more.[10] Previous research in Australia found that general practitioners who agreed that IT was useful were more likely to experience higher work-life balance.[11]

This paper examined first; the factors associated with the uptake of digital health technology by physicians, and second; the association between the use of digital health technology and physicians' job satisfaction and work-life balance.

2 Methods

2.1 Patient and public involvement statement

No patient or public is involved in this study.

2.2 Source of data

The 11th wave of the Medicine in Australia: Balancing Employment and Life (MABEL) survey was used, which was administered between September 2018 and April 2019. MABEL is an annual longitudinal survey of around 10,000 physicians in clinical practice focusing on workforce participation, labor supply and its determinants. The survey is representative of the physicians population in Australia, and provides information on physician characteristics, family circumstances, geographic location, qualifications, and practice settings.

The 11th wave of the survey included questions on the use of digital health technology.[12] These questions were developed based on previous systematic literature reviews,[2,3] selective interviews with a small number of physicians, and previous research conducted by the Australian Department of Health and the Australian Digital Health Agency.[13–15] The questions were pre-tested in a pilot survey with several changes made to the questions in the main survey. The questions were designed to be the same across the many contexts, work settings, and specialties in which physicians work.

2.3 Study population

The first wave of MABEL was conducted in 2008, where the population of 54,750 physicians in clinical practice in Australia were invited to participate in the survey. The 10,498 doctors who participated in the baseline cohort were representative of the population of physicians in Australia in 2008 with respect to age, gender, and geographic location.[16,17] In each subsequent wave, a new cohort of physicians were invited to participate in the survey in addition to all those who participated in the survey in the previous waves. For each wave, a paper copy of the survey questionnaire and online login information was mailed to the registered address of the physicians, followed with three reminders. Physicians in rural areas received an AUD100 cheque along with the invitation to participate in the survey.[18]

The questionnaire of the 11th wave of MABEL was sent to 27,829 physicians where 17,103 physicians had previously responded to the earlier waves, 4,525 were new to the sample frame, and 4,698 were from a ten percent boost sample of physicians who previously never responded.[18]

2.3.1 Digital health technology

Physicians' 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 following purposes: viewing pathology or diagnostic imaging results, viewing medicines information, completing or viewing event summaries such as discharge summaries or specialist reports, entering, updating patient information during or after consultations or procedures, communicating or messaging with other clinicians about patient care, sending or receiving referrals from other health practitioners, using digital decision support tools to help inform clinical decisions such as clinical dashboards; automated alerts, warnings, and reminders; algorithms; electronic clinical guidelines and pathways, ordering pathology tests or diagnostic imaging, writing prescriptions, viewing patient information entered by the other physicians, viewing immunization information, clinical audit and research and storing advanced care planning documents.

2.3.2 Job satisfaction and work-life balance

Job satisfaction was measured using the 10-item short version of the Warr-Cook-Wall Job Satisfaction Scale.[19,20] This was validated in the MABEL cohort of Australian clinical medical practitioners.[21] Overall job satisfaction was coded as a binary variable equal to one for respondents who answered, “moderately satisfied” or “very satisfied” to the question asking: “Taking everything into account, how do you feel about your work.” Work-life balance was defined as a binary variable equal to one for respondents who answered “agree” or “strongly agree” to the question asking: “The balance between my personal and professional commitments is about right.”

2.3.3 Other variables

The analyses included several control variables that have been shown to influence job satisfaction and work-life balance: gender, age, marital status (single as the base, living in with a partner), spouse employment status (unemployed or not applicable as the base, full time or part-time), having at least one child below five years old, geographic location including whether in a metropolitan area, state, and socio-economic status of the postcode measured by the Socio-Economic Indexes For Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD).[22] This index is constructed by the Australian Bureau of Statistics based on information from the five-yearly Census. A low score indicates relatively greater disadvantage and a lack of advantage and a high score indicates a relative lack of disadvantage and greater advantage. Other variables included whether the physician worked in public, private or both public and private practices, whether they were an overseas trained physician, whether they graduated from one of the top-eight Australian medical schools, and whether they held a fellowship of their college. Also, personality traits were measured using the 15-item factor model.[23] The big-five personality traits included in the models were extraversion, agreeableness, conscientiousness, neuroticism, and openness, and were standardized to have a mean of zero and standard deviation of one.

The survey also asked for physicians' attitudes and beliefs about the use of digital health technology in four main areas: effectiveness of digital health technology, data sharing and privacy concerns, peer effects, and the 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."

3 Statistical analysis

Descriptive statistics of all variables were presented. Differences between physicians who used digital health technology and those who did not were tested using two-sided t-tests for the means and proportions. Multivariate probit regressions were used, given the binary nature of the outcome variables. The first model included the use of digital health technology as the dependent variable to examine the association between using digital health technologies with physicians' beliefs about its effectiveness, peer effects, IT support and privacy concerns, and physicians' characteristics.

The second and third probit models used job satisfaction and work-life balance as outcome variables to examine the association with the use of digital health technology. Although a rich set of control variables were included, there may be unobserved confounding factors that are correlated with the decision to use digital health technology. Further, these models might suffer from reverse causality (simultaneity) where physicians with higher job satisfaction or good work-life balance might also be more likely to use digital health technology, resulting in an overestimation of the size of the association from the probit models. To adjust for these potential biases, probit models with an instrumental variable were estimated using a maximum likelihood method.[24] An instrumental variable is an observable factor related to physicians' choice of using digital health technology, but unrelated to their work satisfaction or work-life balance. We used physicians' beliefs about the effectiveness of digital health technology for improving the care process as an instrumental variable for using digital health technology since it had the strongest association with the use of digital health technology from our first model. The Wald statistics were constructed to test the exogeneity of the instrumental variable, whether it was correlated with the error term of the job satisfaction and work-life balance probit models, which is a required condition for the validity of the analysis.[25]

All the estimates from probit models were presented in terms of the average marginal effect, which indicate the change in the probability of the outcome variable due to one-unit change in the corresponding independent variable. The standard errors were clustered at the postcode level to account for the correlations between respondents in the same geographic area due to similar internet speeds and similarity of the population and doctors within the same geographical area. Probability weights were used to adjust the descriptive statistics and the regression models to be representative of the population in terms of age, gender, physician type and location.[18]

3.1 Results

Of the 8,878 physicians who responded to the survey, 7,670 physicians (86.4%) used digital health technology, where 35.9% were general practitioners (17.6% used digital health technology), 41.7% were other specialists (61.9% users), and the remaining 22.4% were physician in training (17.7% users).

Table 1: Descriptive characteristics of the physicians

Characteristics (portion)	Do not use digital health technology (N = 1,208)	Use digital health technology (N = 7,670)	p-value
Age (mean)	37.856	47.034	<0.001
Male (=1)	0.589	0.552	0.173
Live in partner (=1)	0.292	0.799	<0.001
Spouse labor force status			
- Not in labor force/NA	0.791	0.388	<0.001
- Part-time employment	0.151	0.340	<0.001
- Full-time employment	0.057	0.270	<0.001
Young child (=1)	0.086	0.095	0.373
Foreign graduate (=1)	0.255	0.231	0.156
Top eight Australian university graduate (=1)	0.630	0.572	0.002
Fellowship of college (=1)	0.683	0.698	0.340
Metropolitan area (=1)	0.774	0.751	0.153
Practice setting			
- Public only	0.050	0.408	<0.001
- Private only	0.107	0.273	<0.001
- Private and public	0.842	0.317	<0.001
Socio-Economic Indexes for Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD) (mean)	1,040.791	1,031.106	0.009
General practitioners	0.176	0.203	0.016
Specialists	0.688	0.619	<0.001
Physician in training	0.135	0.177	0.001
Colleagues and support staff already extensively use digital health technology	0.041	0.666	<0.001
Believing in digital health technology improve care processes (e.g. improve care coordination, continuity of care and reduce duplication)	0.043	0.644	<0.001
Has no concerns about data privacy or security	0.022	0.141	<0.001
Receiving support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, and back-ups)	0.033	0.489	<0.001
Personality trait: Extraversion (standardized mean)	0.039	-0.019	0.179
Personality trait: Agreeableness (standardized mean)	0.019	-0.052	0.087
Personality trait: Consciousness (standardized mean)	0.030	0.018	0.767

Personality trait: Neuroticism (standardized mean)	-0.009	0.009	0.671
Personality trait: Openness (standardized mean)	0.104	0.012	0.025
Job satisfaction	0.137	0.397	<0.001
Work-life balance	0.172	0.563	<0.001
Productivity (number of patients per hour) (mean)	1.155	1.457	0.019

Note: Of the 27,929 physicians who sent a survey, 9,361 responded (33.5%). These were slightly under-represented in the 40-59-year-old age groups and over-represented by women (48.3% versus 40.9% in the population). 35.1% were general practitioners, compared to 41.1% in the population; 41% were specialists compared to 38.9% in the population; 17.5% were pre-vocational physician in training compared to 14% in the population, and; 6.4% were doctors in vocational (specialty) training programs compared to 6% in the population. Respondents were more closely representative of location in terms of state, and there was a higher proportion from non-metropolitan areas (24% versus 29.9% from metropolitan areas).[18] Probability weights were used to adjust the descriptive statistics.

Table 1 compares the characteristics of the physicians who used digital health technology with those who did not. 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. Users were more likely to hold fellowship of their college, less likely to be a foreign graduate, and more likely to work either in solely public or private practice. Most of the physicians who used digital health technology had positive beliefs about the effectiveness of digital health technology on improving the care process, had colleagues who also used it, had IT support in their practice, and had no privacy concerns.

The estimates of average marginal effects from the factors associated with the probability of using digital health technology are shown in Table 2, with full results provided in Table A.3 in the Appendix. After adjusting for the variables presented in Table 1, positive beliefs about the effectiveness of digital health technology for improving the care process and having colleagues who use digital health technology in their practice were associated with an increase in the probability of using digital health technology of 3.8 (95% CI, 0.027 to 0.050) and 4.1 (95% CI, 0.026 to 0.056) percentage points, respectively. Availability of IT support (1.6 percentage points: 95% CI, 0.010 to 0.023) and lack of privacy concerns (0.5 percentage points; 95% CI, 0.001 to 0.010) were also associated with an increase in the probability of uptake. Respondents aged between 40 to 59 years old were more likely to use digital health technology compared with those below 40 years old, but the effects were quite small. Physicians with live-in partners who worked part-time compared to not working, physicians working in public or private practice only, compared to working in both sectors were also more likely to use digital health technology. Lower uptake was more likely for physicians with young children, those who graduated overseas, graduates from a top Australian university, and physicians with the primary location of practice in the areas with lower socio-economic status, though these effects were small. The association between the uptake of digital health technology and physicians' big-five personality traits were quite weak.

Table 2: Factors affecting uptake of digital health technology

Factors affecting uptake of digital health technology (agree/strongly agree with statements below)	Average marginal effects on the probability of using digital health technology (95% CI)
Colleagues and support staff already extensively use digital health technology	0.041 (0.026,0.056)
Digital health technology improves care processes (e.g. improve care coordination, continuity of care and reduce duplication)	0.038 (0.027,0.050)
I have no concerns about data privacy or security	0.005 (0.001,0.010)
I receive support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, and back-ups)	0.016 (0.010,0.023)

Note: This table presents the estimated change in the probability of using digital health technology from a probit regression model. The estimates are adjusted for physicians' characteristics shown in Table 1, with full results presented in Table A.3. The 95% Confidence Intervals (CI) presented in the parenthesis are based on standard errors clustered at the postcode level.

Estimates of the average marginal effects of using digital health technology on the probabilities of high job satisfaction and good work-life balance are shown in Table 3. Using digital health technology increased the probability of higher job satisfaction and having better work-life balance in both unadjusted and adjusted models. After adjusting for endogeneity/confounding using an instrumental variable, the estimates were slightly smaller but still relatively large. The estimate of the average marginal effect on the probability of having high job satisfaction fell from 16.2 (95% CI, 0.112 to 0.212) in the adjusted analysis to 14.2 percentage points (95% CI, -0.013 to 0.297) in the instrumental variable analysis. The estimated effect on work-life balance fell from 23.2 (95% CI, 0.176 to 0.287) to 20.3 percentage points (95% CI, 0.024 to 0.381) in the instrumental variable analysis. The CIs were wider in the instrumental variable analysis, suggesting a higher level of uncertainty around the size of the effect of digital health technology on the two outcomes. The goodness of fit of the models were higher when the instrumental variable was used.

The Wald statistics for testing exogeneity of the instrumental variable were 23.99 and 15.11 from the analysis for job satisfaction and work-life balance, respectively. The p-values for both statistics were <0.001, suggesting validity of the instrumental variable by rejecting the null hypothesis of a non-zero correlation between the instrumental variable and the error terms in the models.

Table 3: Estimated average marginal effect on the probability of job satisfaction and work-life balance from using digital health technology

Model	Estimated average marginal effect on the probability (95% CI)
Job satisfaction	
Unadjusted analysis	0.174 (0.102,0.246)
Adjusted analysis	0.162 (0.112,0.212)
- General Practitioners only	0.246 (0.180,0.313)
- Specialists only	0.107 (0.021,0.193)
- Physician in training only	0.080 (-0.038,0.198)
Adjusted IV analysis	0.142 (-0.013,0.297)
p-value of Wald test of exogeneity < 0.001	
Work-life balance	
Unadjusted analysis	0.283 (0.198,0.367)
Adjusted analysis	0.232 (0.176,0.287)
- General Practitioner only	0.213 (0.125,0.301)
- Specialist only	0.176 (0.086,0.2767
- Physician in training only	0.194 (0.075,0.312)
Adjusted IV analysis	0.203 (0.024,0.381)
p-value of Wald test of exogeneity < 0.001	
Productivity	
Adjusted linear regression analysis	0.238 (0.041,0.434)

Note: This table presents the estimated average marginal change in the probability of job satisfaction, work-life balance, and productivity from using digital health technology. Each estimate is from a separate probit regression model that includes a full set of covariates from Table 1. All the adjusted estimates include the state the practice is located and the physicians' personality traits. The estimates for the specialists are adjusted for their specialties. All the estimates are also adjusted for the cross-sectional survey weights. The 95% Confidence Intervals (CI), presented in the parenthesis are based on standard errors clustered at the postcode level. Detailed estimates are shown in Table A.1, Table A.2, and Table A.3.

4 Discussion

In this nationally representative study of 8,878 Australian physicians, positive beliefs about the effect of digital health technology on improving the care process and having colleagues who use digital health technology had the strongest association with the use of digital health technology, followed by having IT support, and lack of privacy concerns. There was a strong association between the use of digital health technology and job satisfaction and work-life balance. The largest effects were for general practitioners, followed by specialists and physicians in training. These positive associations persisted after controlling for physicians' practice and personal characteristics, including their personality traits, and using an instrumental variable to adjust for the bias dues to reverse causality and unobservable confounders.

Previous research has produced mixed results on the effects of using digital health technology on various aspects of physicians work; some showing that it benefits some aspects of physicians' work,[8,26,27] and other studies showing that it does not or provide mixed results.[4–7,28] This is the first study to examine the association between using digital health technology with physicians' job satisfaction and builds on a previous study examining the associations with the work-life balance.[11] 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. 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 biased due to reverse causality issue and confounding factors. There still could be other unobserved factors that were not controlled for, requiring a cautious interpretation of the findings.

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

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Contributorship statement

- AZ conducted the literature search, statistical analysis, and contributed to data interpretation and drafting the manuscript.
- AS provided management oversight of the project and contributed to data interpretation and drafting the manuscript.

Appendix: Regressions

Table A.1: Estimated average marginal effects of using digital health technology on the probability of high job satisfaction

	(1)	(2)	(3)	(4)	(5)
Models	All physicians Probit	All physicians IV-Probit	General Practitioners only Probit	Specialists only Probit	Doctors in training only Probit
Using digital health technology	0.162	0.142	0.246	0.107	0.080
	(0.112,0.212)	(-0.013,0.297)	(0.180,0.313)	(0.021,0.193)	(-0.038,0.198)
Specialists	0.098	0.107			
	(0.060,0.136)	(0.068,0.145)			
Physician in training	-0.032	-0.027			
	(-0.085,0.020)	(-0.079,0.025)			
Male	0.007	0.007	-0.024	0.010	0.040
	(-0.022,0.035)	(-0.022,0.036)	(-0.074,0.026)	(-0.038,0.059)	(-0.007,0.088)
Age: 40-49 years	-0.046	-0.042	0.001	-0.091	-0.028
	(-0.088,-0.004)	(-0.086,0.002)	(-0.066,0.067)	(-0.165,-0.017)	(-0.119,0.064)
Age: 50-59 years	-0.030	-0.025	0.020	-0.074	0.109
	(-0.081,0.021)	(-0.077,0.027)	(-0.046,0.086)	(-0.156,0.009)	(-0.046,0.265)
Age: +60 years	0.080	0.090	0.088	0.046	0.203
	(0.027,0.134)	(0.036,0.144)	(0.019,0.157)	(-0.042,0.134)	(-0.022,0.428)
Live in partner	0.073	0.073	0.059	0.047	0.092
	(0.035,0.112)	(0.033,0.113)	(-0.006,0.125)	(-0.017,0.111)	(0.038,0.146)
Young child	-0.070	-0.069	-0.062	-0.103	-0.039
	(-0.111,-0.029)	(-0.111,-0.027)	(-0.135,0.012)	(-0.171,-0.036)	(-0.100,0.022)
Spouse: Full-time employment	-0.024	-0.024	-0.029	-0.024	-0.044
	(-0.059,0.011)	(-0.060,0.011)	(-0.084,0.027)	(-0.077,0.029)	(-0.109,0.020)
Spouse: Part-time employment	-0.055	-0.054	-0.029	-0.064	-0.079
	(-0.095,-0.015)	(-0.094,-0.013)	(-0.088,0.031)	(-0.121,-0.006)	(-0.156,-0.002)
Practice setting: Public only	-0.011	-0.017	0.065	0.000	0.102
	(-0.046,0.023)	(-0.059,0.025)	(-0.057,0.187)	(-0.044,0.045)	(0.026,0.178)
Practice setting: Private only	0.132	0.130	0.114	0.149	0.256
	(0.089,0.176)	(0.083,0.176)	(0.056,0.172)	(0.089,0.210)	(0.072,0.439)
Metropolitan area	-0.068	-0.067	-0.099	-0.027	-0.089
	(-0.107,-0.030)	(-0.106,-0.028)	(-0.151,-0.046)	(-0.093,0.040)	(-0.165,-0.013)
Socio-Economic	0.118	0.116	0.213	0.052	-0.073

Indexes for Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD)					
	(-0.105,0.341)	(-0.111,0.343)	(-0.112,0.539)	(-0.297,0.401)	(-0.428,0.282)
Foreign graduate	-0.007	-0.012	-0.081	0.038	-0.031
	(-0.048,0.033)	(-0.052,0.028)	(-0.143,-0.019)	(-0.021,0.096)	(-0.114,0.052)
Top eight Australian university graduate	0.018	0.016	-0.008	0.042	-0.023
	(-0.021,0.057)	(-0.023,0.055)	(-0.065,0.048)	(-0.014,0.098)	(-0.082,0.036)
Fellowship of college	0.045	0.047	0.051	0.050	-0.015
	(0.008,0.083)	(0.010,0.084)	(0.007,0.094)	(-0.032,0.132)	(-0.130,0.099)
Personality trait: Extraversion	0.093	0.093	0.103	0.102	0.073
	(0.077,0.109)	(0.077,0.110)	(0.078,0.128)	(0.079,0.125)	(0.045,0.102)
Personality trait: Agreeableness	0.027	0.025	0.031	0.026	0.027
	(0.010,0.043)	(0.008,0.041)	(0.006,0.055)	(0.001,0.051)	(0.001,0.053)
Personality trait: Consciousness	0.008	0.008	0.006	0.011	-0.005
	(-0.006,0.022)	(-0.006,0.022)	(-0.017,0.028)	(-0.011,0.033)	(-0.029,0.018)
Personality trait: Neuroticism	-0.000	-0.000	0.009	-0.005	0.005
	(-0.014,0.014)	(-0.014,0.014)	(-0.013,0.032)	(-0.027,0.018)	(-0.018,0.027)
Personality trait: Openness	-0.016	-0.016	-0.019	-0.020	-0.017
	(-0.031,-0.002)	(-0.030,-0.001)	(-0.043,0.005)	(-0.042,0.001)	(-0.039,0.005)
Wald statistics for exogeneity test [p-value]		23.990 [0.000]			
State	Yes	Yes	Yes	Yes	Yes
Specialty	No	No	No	Yes	No
Pseudo R2	0.075	0.225	0.072	0.082	0.069
Number of observations	7,043	7,043	2,491	2,776	1,651

Note: See notes to Table 3.

Table A.2: Estimated average marginal effects of using digital health technology on the probability of work-life balance

	(1)	(2)	(3)	(4)	(5)
Models	All physicians Probit	All physicians IV-Probit	General Practitioners only Probit	Specialists only Probit	Doctors in training only Probit
Using digital health technology	0.232	0.203	0.213	0.176	0.194
	(0.176,0.287)	(0.024,0.381)	(0.125,0.301)	(0.086,0.267)	(0.075,0.312)
Specialists	0.122	0.129			
	(0.081,0.164)	(0.088,0.171)			
Physician in training	-0.078	-0.074			
	(-0.136,-0.021)	(-0.133,-0.016)			
Male	0.008	0.009	-0.053	0.009	0.047
	(-0.025,0.042)	(-0.025,0.043)	(-0.104,-0.002)	(-0.039,0.057)	(-0.003,0.097)
Age: 40-49 years	-0.072	-0.068	-0.089	-0.104	0.015
	(-0.116,-0.028)	(-0.112,-0.024)	(-0.156,-0.023)	(-0.167,-0.042)	(-0.088,0.118)
Age: 50-59 years	-0.047	-0.042	-0.039	-0.090	0.196
	(-0.096,0.001)	(-0.089,0.005)	(-0.106,0.027)	(-0.159,-0.021)	(0.031,0.361)
Age: +60 years	0.041	0.050	0.048	0.005	0.166
	(-0.008,0.090)	(0.001,0.099)	(-0.018,0.115)	(-0.067,0.077)	(-0.056,0.388)
Live in partner	0.094	0.094	0.037	0.103	0.045
	(0.053,0.135)	(0.047,0.140)	(-0.028,0.102)	(0.033,0.173)	(-0.024,0.115)
Young child	-0.098	-0.097	-0.031	-0.134	-0.117
	(-0.145,-0.051)	(-0.148,-0.046)	(-0.105,0.044)	(-0.213,-0.054)	(-0.195,-0.039)
Spouse: Full-time employment	-0.037	-0.038	-0.028	-0.052	0.000
	(-0.073,-0.001)	(-0.073,-0.002)	(-0.084,0.028)	(-0.107,0.003)	(-0.070,0.070)
Spouse: Part-time employment	-0.033	-0.031	0.010	-0.059	0.011
	(-0.076,0.011)	(-0.076,0.014)	(-0.051,0.070)	(-0.115,-0.003)	(-0.119,0.142)
Practice setting: Public only	0.087	0.082	0.221	0.078	0.123
	(0.046,0.127)	(0.030,0.133)	(0.086,0.357)	(0.026,0.131)	(0.035,0.211)
Practice setting: Private only	0.204	0.201	0.207	0.183	0.397
	(0.161,0.248)	(0.151,0.251)	(0.147,0.268)	(0.129,0.237)	(0.198,0.596)
Metropolitan area	0.005	0.006	0.047	-0.002	-0.040
	(-0.036,0.045)	(-0.034,0.047)	(-0.006,0.100)	(-0.069,0.065)	(-0.114,0.034)
Socio-Economic	-0.182	-0.187	0.029	-0.236	-0.222

Indexes for Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD)					
	(-0.455,0.090)	(-0.463,0.088)	(-0.305,0.363)	(-0.656,0.184)	(-0.659,0.214)
Foreign graduate	0.016	0.012	-0.045	0.066	0.023
	(-0.025,0.057)	(-0.029,0.052)	(-0.112,0.022)	(0.010,0.123)	(-0.080,0.126)
Top eight Australian university graduate	0.048	0.046	-0.012	0.079	0.025
	(0.010,0.086)	(0.008,0.084)	(-0.071,0.047)	(0.020,0.139)	(-0.040,0.090)
Fellowship of college	0.034	0.036	0.039	0.057	-0.090
	(-0.005,0.073)	(-0.003,0.075)	(-0.009,0.086)	(-0.022,0.136)	(-0.198,0.018)
Personality trait: Extraversion	0.064	0.064	0.039	0.069	0.081
	(0.050,0.079)	(0.049,0.079)	(0.014,0.065)	(0.048,0.090)	(0.050,0.112)
Personality trait: Agreeableness	0.010	0.008	-0.014	0.016	0.025
	(-0.006,0.025)	(-0.008,0.023)	(-0.037,0.010)	(-0.005,0.037)	(-0.005,0.055)
Personality trait: Consciousness	-0.009	-0.010	-0.005	-0.007	-0.023
	(-0.025,0.006)	(-0.025,0.006)	(-0.026,0.017)	(-0.028,0.014)	(-0.053,0.007)
Personality trait: Neuroticism	-0.011	-0.011	-0.005	-0.014	-0.007
	(-0.025,0.003)	(-0.025,0.003)	(-0.028,0.017)	(-0.036,0.008)	(-0.035,0.020)
Personality trait: Openness	-0.044	-0.043	-0.035	-0.044	-0.037
	(-0.059,-0.028)	(-0.059,-0.027)	(-0.059,-0.010)	(-0.066,-0.022)	(-0.063,-0.012)
Wald statistics for exogeneity test [p-value]		15.110 [0.000]			
State	Yes	Yes	Yes	Yes	Yes
Specialty	No	No	No	Yes	No
Pseudo R2	0.021	0.217	0.062	0.070	0.068
Number of observations	7,043	7,043	2,491	2,776	1,651

Note: See notes to Table 3.

Table A.3: Estimated effects on uptake of digital health technology and productivity

	Average marginal effect on the probability of using digital health technology Probit (95% CI)
Colleagues and support staff already extensively use digital health technology	0.041
	(0.026,0.056)
Digital health technology improves care processes (e.g. improve care coordination, continuity of care and reduce duplication)	0.038
	(0.027,0.050)
I have no concerns about data privacy or security	0.005
	(0.001,0.010)
I receive support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, and back-ups)	0.016
	(0.010,0.023)
Productivity	
Specialists	-0.002
	(-0.006,0.002)
Physician in training	-0.004
	(-0.012,0.003)
Male	0.003
	(-0.000,0.007)
Age: 40-49 years	0.011
	(0.005,0.018)
Age: 50-59 years	0.007
	(0.001,0.014)
Age: +60 years	-0.003
	(-0.012,0.006)
Live in partner	0.015
	(0.005,0.026)
Young child	-0.009
	(-0.017,-0.001)
Spouse: Full time employment	0.002
	(-0.004,0.008)
Spouse: Part time employment	0.007
	(0.001,0.013)
Practice setting: Public only	0.030
	(0.018,0.042)
Practice setting: Private only	0.021
	(0.012,0.031)
Metropolitan area	0.002
	(-0.003,0.007)
Socio-Economic Indexes for Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD)	-0.013
	(-0.037,0.010)
Foreign graduate	-0.007
	(-0.015,-0.000)
Top eight Australian university graduate	-0.005
	(-0.010,-0.000)
Fellowship of college	0.000

	(-0.004,0.005)
Personality trait: Extraversion	-0.001
	(-0.004,0.001)
Personality trait: Agreeableness	-0.000
	(-0.002,0.002)
Personality trait: Consciousness	0.001
	(-0.001,0.003)
Personality trait: Neuroticism	0.002
	(-0.000,0.004)
Personality trait: Openness	-0.000
	(-0.002,0.001)
State	Yes
Pseudo R2	0.464
Number of observations	7,043

Note: See notes to Table 3.

BMJ Open

Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance? A Cross-Sectional National Survey and Regression Analysis Using an Instrumental Variable

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-041690.R1
Article Type:	Original research
Date Submitted by the Author:	21-Oct-2020
Complete List of Authors:	Zaresani, Arezou; University of Manitoba, Economics Scott, Anthony; University of Melbourne
Primary Subject Heading:	Health economics
Secondary Subject Heading:	Health informatics, Health policy
Keywords:	Information management < BIOTECHNOLOGY & BIOINFORMATICS, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS

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Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance? A Cross-Sectional National Survey and Regression Analysis Using an Instrumental Variable

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Abstract

Objectives

To examine the association between physicians' use of digital health technology and their job satisfaction and work-life balance.

Design

A cross-sectional nationally representative survey of physicians and probit regression models were used to examine the association between using digital health technology and the probability of reporting high job satisfaction and a good work-life balance. Models included a rich set of covariates, including physicians' personality traits, and instrumental variable analysis was used to control for bias from unobservable confounders and reverse causality.

Setting

Clinical practice settings in Australia, including physicians working in primary care, hospitals, outpatient settings, and physicians working in the public and private sectors.

Participants

Respondents to Wave 11 (2018-19) of the Medicine in Australia: Balancing Employment and Life (MABEL) longitudinal survey of doctors. The analysis sample included a broadly nationally representative sample of 7,043 physicians, including general practitioners, specialists, and physicians in training.

Primary and secondary outcome measures

The proportion of respondents who used any digital health technology; proportion answered *"moderately satisfied"* or *"very satisfied"* to the statement on job satisfaction: *"Taking everything into account, how do you feel about your work";* proportion agreeing or strongly agreeing to the statement on work-life balance: *"The balance between my personal and professional commitments is about right."*

Results

Physicians with positive beliefs about the effectiveness of using digital health technology were 3.8 percentage points (95% Confidence Interval (CI), 2.7 to 5.0) more likely to use digital health technology compared with those who did not. Physicians with colleagues who already used digital health technology were also 4.1 percentage points (95% CI, 2.6 to 5.6) more likely to use digital health technology. The availability of IT support and lack of privacy concerns increased the probability of using digital health technology by 1.6 percentage points (95% CI, 1.0 to 2.3) and 0.5 percentage points (95% CI, 0.1 to 1.0). Physicians who used digital health technology were 14.2 percentage points (95% CI, -1.3 to 29.7) and 20.3 percentage points (95% CI, 2.4 to 38.1) more likely to report respectively higher job satisfaction and good work-life balance, compared with the physicians who did not use it.

Conclusions

Findings suggested digital health technology served more as a work resource than work demand for physicians who used it.

Article Summary

Strength and limitations:

- Provided new evidence on how physicians' use of digital health technology improves their job satisfaction and work-life balance.
- Used a unique and rich data from the Medicine in Australia: Balancing Employment and Life (MABEL) survey, including physicians' personality traits.
- Instrumental variables were used to account for reverse causality issues and unobserved confounding factors.
- The data was a cross-sectional survey, and there could be other unobserved factors that were not controlled for, requiring a cautious interpretation of the findings.

Conflict of interest statement

The two authors have no conflict of interest to declare. This study is not previously published and is not currently under review elsewhere.

Data sharing statement

For more information on how to access MABEL data, see:
https://melbourneinstitute.unimelb.edu.au/mabel/for-researchers/data

Funding statement

This research was funded by the Australian Digital Health Agency. We used data from the Medicine in Australia: Balancing Employment and Life (MABEL) longitudinal survey. Funding for MABEL was provided by the National Health and Medical Research Council (2007–2016:

454799 and 1019605); the Australian Government Department of Health and Ageing (2008); Health Workforce Australia (2013); and in 2017, The University of Melbourne, Medibank Better Health Foundation, New South Wales Department of Health, and Victorian Department of Health and Human Services. In 2018, MABEL was funded by the Australian Government Department of Health, Victorian Department of Health and Human Services, and the Australian Digital Health Agency. The study was approved by The University of Melbourne Faculty of Business and Economics Human Ethics Advisory Group (Ref: 0709559) and the Monash University Standing Committee on Ethics in Research Involving Humans (Ref: CF07/1102–2007000291).

Keywords: digital health technology; electronic health records; job satisfaction; work-life balance; eHealth; mobile health systems; telehealth.

Word count: 3,340.

1 Introduction

Digital health technology, such as shared electronic health records, can improve information flow between healthcare providers and between providers and patients. Convincing busy physicians to use digital health technology (see Table 1) in their practice requires evidence on the benefits to patients and evidence on the benefits and costs to the physicians themselves. There is a potential for digital health technology to save physicians' time by accessing patients' medical records, test results, and medication information more quickly. Through sharing more standard information and making such information available at the point of care, digital health technology can reduce duplication of tests, reduce medication errors, and improve patient safety. However, digital health technology can also be an additional work demand as extra time is needed to input patients' health information into the electronic record and read and interpret the other healthcare providers' information. The net impact of these factors influences physicians' decision to use digital health technology.

Physicians' use of digital health technology is determined by a range of factors that have been summarised in previous literature reviews and qualitative research.[1–3] Previous systematic reviews on the impact of using digital health technology on time use,[4] health outcomes, patient satisfaction, and processes of patient care[5–7] 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.[8] 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.[10] Previous research in Australia found that general practitioners who agreed that IT was useful were more likely to experience higher work-life balance.[11]

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)

This paper aims to examine the factors associated with the use of digital health technology by physicians and then examine the association between the use of digital health technology and physicians' job satisfaction and work-life balance.

1.1 Australian healthcare system

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.[12] 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 Methods

2.1 Patient and public involvement statement

There was no patient or public involvement in this study.

2.2 Source of data

The Medicine in Australia: Balancing Employment and Life (MABEL) survey is an annual longitudinal survey of physicians in clinical practice focusing on workforce participation, labor supply, and its determinants. The survey is representative of the physicians' population in Australia and provides information on physicians' characteristics, family circumstances, geographic location, qualifications, and practice settings. The first wave of MABEL was conducted in 2008, where the population of 54,750 physicians in clinical practice in Australia were invited to participate in the survey. The 10,498 doctors who participated in the baseline cohort were representative of the physicians' population in Australia in 2008 with respect to age, gender, and geographic location.[13,14] In each subsequent wave, a new cohort of physicians were invited to participate in the survey in addition to all those who participated in the survey in the previous waves. A paper copy of the survey questionnaire and online login information was mailed to the physicians' work address, followed by three reminders for each wave. Physicians in rural areas received an AUD$ 100 cheque along with the invitation to participate in the survey.[15]

2.3 Study population

The 11th wave of the MABEL questionnaire was sent to 27,829 physicians in August 2018. This included 17,103 physicians who had previously responded to the earlier waves, 4,525 who were new to the sample frame, and 4,698 from a 10% boost sample of physicians who previously never responded.[15]

2.3.1 Digital health technology

The 11th wave of the survey included new questions on the use of digital health technology.[16] These questions were developed based on previous systematic literature reviews,[2,3] selective interviews with a small number of physicians, and previous research conducted by the Australian Department of Health and the Australian Digital Health Agency.[17–19] 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."*

2.3.2 Job satisfaction and work-life balance

Job satisfaction was measured using the 10-item short version of the Warr-Cook-Wall Job Satisfaction Scale.[20,21] This was validated in the MABEL cohort of Australian clinical medical practitioners.[22] Overall job satisfaction was coded as a binary variable equal to one for respondents who answered *"moderately satisfied"* or *"very satisfied"* to the question asking: *"Taking everything into account, how do you feel about your work."* Work-life balance was defined as a binary variable equal to one for respondents who answered *"agree"* or *"strongly agree"* to the question asking*: "The balance between my personal and professional commitments is about right."*

2.3.3 Other variables

The analyses included several control variables that have been shown to influence job satisfaction and work-life balance: gender, age, marital status (single as the base, living in with a partner), spouse employment status (unemployed or not applicable as the base, full time or part-time), having at least one child below five years old, geographic location including whether in a metropolitan area, state, and socio-economic status of the postcode measured by the Socio-Economic Indexes For Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD).[23] This index is constructed by the Australian Bureau of Statistics based on information from the five-yearly Census, where higher scores indicate greater advantage.

Other variables included whether the physician worked in the public, private, or both public and private sectors, whether they were an overseas trained physician, whether they graduated from one of the top-eight Australian medical schools, and whether they held a fellowship of their college. Physicians' personality traits were measured using the 15-item factor model.[24] The big-five personality traits included in the models were extraversion, agreeableness, conscientiousness, neuroticism, and openness, and were standardized to have a mean of zero and standard deviation of one.

3 Statistical analysis

Descriptive statistics of all variables were presented. Differences between physicians who used digital health technology and those who did not were tested using two-sided t-tests for the means and proportions. Multivariate probit regression models were used, given the binary nature of the outcome variables, the use of instrumental variables estimation, and the ease of interpreting results as changes in proportions. The first model included the use of digital health technology as the dependent variable to examine the association between using digital health technology with peer effects, physicians' believe about the effectiveness of digital health technology, data sharing and privacy concerns, availability of IT support and physicians' characteristics, including their personality traits.

The second and third probit models used job satisfaction and work-life balance as outcome variables to examine the association with the use of digital health technology. Although a rich set of control variables were included, there may be unobserved confounding factors correlated with the decision to use digital health technology.

Further, these models might suffer from reverse causality (simultaneity) where physicians with higher job satisfaction or good work-life balance might also be more likely to use digital health technology, resulting in an overestimation of the size of the association from the probit models. To adjust for these potential biases, probit models with an instrumental variable were estimated using a maximum likelihood method.[25]

An instrumental variable is an observable factor related to physicians' choice of using digital health technology, but unrelated to their work satisfaction or work-life balance. We used physicians' beliefs about digital health technology's effectiveness for improving the care process as an instrumental variable for using digital health technology since it had the strongest association with the use of digital health technology from our first model. The Wald statistics were constructed to test the exogeneity of the instrumental variable, whether it was correlated with the error term of the job satisfaction and work-life balance probit models, which is a required condition for the validity of the analysis.[26]

Probability weights were used to adjust the descriptive statistics and the regression models to represent the population regarding age, gender, physician type, and location.[15] All the estimates from probit models were presented in terms of the average marginal effect, which indicates the change in the probability of the outcome variable due to a one-unit change in the corresponding independent variable. The standard errors were clustered at the postcode level to account for the correlations between respondents in the same geographic area due to similar internet speeds and similarity of the population and physicians within the same geographical area.

3.1 Results

Of the 27,929 physicians whom to the survey was sent, 9,361 responded (33.5%). These were slightly under-represented in the 40-59-year-old age groups and over-represented by women (48.3% versus 40.9% in the population). 35.1% were general practitioners, compared to 41.1% in the population; 41% were specialists compared to 38.9% in the population; 17.5% were a pre-vocational physician in training compared to 14% in the population, and; 6.4% were doctors in vocational (specialty) training programs compared to 6% in the population. Respondents were more closely representative of location in terms of state, and there was a higher proportion from non-metropolitan areas (24% versus 29.9% from metropolitan areas).[15]

Our study sample included 7,043 physicians working in clinical practice who answered the digital health technology questions and all the other questions used in the analysis. 6,537 physicians (92.82%) used digital health technology, where 35.4% were general practitioners (19.6% used digital health technology), 41.2% were specialists (61.9% users). The remaining 23.4% were physicians in training (18.7% users).

Figure 1 shows the activities which physicians use digital health technology for, broken down by physicians' type. There is quite lots of variation in how physicians use digital health technology; almost all physicians use digital health technology for viewing pathology and imaging results while less than half of them use digital health technology for sorting advanced care planning documents.

Figure 1: Use of digital health technology among Australian physicians

[INSERT FIGURE 1 HERE]

Note: This figure shows the activities for which Australian physicians use digital health technology, broken down by the physicians' 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."*

Table 2 compares the characteristics of physicians who used digital health technology with those who did not. Physicians who used digital health technology were older, more likely to be male, more likely to have a live-in partner, who was also more likely to be employed (either part-time or full-time). Users were more likely to hold fellowship of their college, and more likely to work either solely in public or private practice than doctors working across both settings. There were no differences in the personality traits between physicians who used and did not use digital health technology. Most of the physicians who used digital health technology had positive beliefs about digital health technology's effectiveness in improving the care process, had colleagues who also used it, had IT support in their practice, and had no privacy concerns. The users also were more likely to be satisfied with their job and have a good work-life balance.

Table 2: Descriptive characteristics of the physicians

Characteristics (portion)	Do not use digital health technology (N = 506)	Use digital health technology (N = 6,537)	p-value
Age (mean)	43.956	47.075	0.044
Male (=1)	0.508	0.558	0.074
Live in partner (=1)	0.551	0.797	<0.001
Spouse labor force status			
- Not in labor force/NA	0.604	0.382	<0.001
- Part-time employment	0.276	0.345	0.006
- Full-time employment	0.119	0.271	<0.001
Young child (=1)	0.155	0.097	0.002
Foreign graduate (=1)	0.227	0.224	0.899
Top eight Australian university graduate (=1)	0.625	0.569	0.035
Fellowship of college (=1)	0.712	0.697	0.511
Metropolitan area (=1)	0.757	0.754	0.870
Practice setting			
- Public only	0.092	0.406	<0.001
- Private only	0.196	0.275	<0.001
- Private and public	0.710	0.317	<0.001
Socio-Economic Indexes for Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD) (mean)	1,039.935	1,031.62	0.048
General practitioners	0.184	0.198	0.401
Specialists	0.645	0.613	0.215
Physicians in training	0.170	0.187	0.403
Colleagues and support staff already extensively use digital health technology	0.080	0.670	<0.001
Believing in digital health technology improve care processes (e.g. improve care coordination, continuity of care and reduce duplication)	0.069	0.641	<0.001
Has no concerns about data privacy or security	0.034	0.144	<0.001
Receiving support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, and back-ups)	0.054	0.479	<0.001
Personality trait: Extraversion (standardized mean)	0.005	-0.100	0.776
Personality trait: Agreeableness (standardized mean)	-0.070	-0.049	0.717

Personality trait: Consciousness (standardized mean)	-0.009	0.022	0.569
Personality trait: Neuroticism (standardized mean)	-0.121	0.003	0.012
Personality trait: Openness (standardized mean)	0.069	0.007	0.240
Job satisfaction (moderately/very satisfied=1)	0.250	0.397	<0.001
Work-life balance (agree/strongly agree=1)	0.314	0.559	<0.001

Note: This table presents the descriptive characteristics of the 7,043 physicians who answered all the questions on the use of digital health technology and other variables used in the regression analysis. The reported proportions and the means are adjusted for the cross-section weights. The reported p-values are from two-sided t-stats testing the null hypothesis that the means and proportions are the same for those who use and those who do not use digital health technology.

The estimates of average marginal effects from the factors associated with the probability of using digital health technology are shown in Table 3, with full results provided in Table A.1 in the Appendix. After adjusting for the variables presented in Table 2, positive beliefs about the effectiveness of digital health technology for improving the care process and having colleagues who used digital health technology in their practice were associated with an increase in the probability of using digital health technology of 3.8 percentage points (95% CI, 0.027 to 0.050) and 4.1 percentage points (95% CI, 0.026 to 0.056), respectively. Availability of IT support (1.6 percentage points: 95% CI, 0.010 to 0.023) and lack of privacy concerns (0.5 percentage points; 95% CI, 0.001 to 0.010) were also associated with increased probability of use. Respondents aged between 40 and 59 were more likely to use digital health technology than those below 40 years old, but the effects were relatively small. Physicians with live-in partners who worked part-time (compared to not working) and physicians working in public or private practice only (compared to working in both sectors) were also more likely to use digital health technology. The probability of using digital health technology was lower for physicians with young children, those who graduated overseas, graduates from top Australian universities, and physicians with the primary location of practice in the areas with lower socioeconomic status. The association between the use of digital health technology and physicians' big-five personality traits were relatively weak.

Table 3: Factors affecting the use of digital health technology

Factors affecting the use of digital health technology (agree/strongly agree with statements below)	Average marginal effects on the probability of using digital health technology (95% CI)
Colleagues and support staff already extensively use digital health technology	0.041 (0.026,0.056)
Digital health technology improves care processes (e.g., improve care coordination, continuity of care, and reduce duplication)	0.038 (0.027,0.050)
I have no concerns about data privacy or security	0.005 (0.001,0.010)
I receive support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, and back-ups)	0.016 (0.010,0.023)

Note: This table presents the estimated change in the probability of using digital health technology from a probit regression model. The estimates are adjusted for physicians' characteristics shown in Table 2, with full results presented in Table A.1 in the Appendix. The study sample includes 7,043 physicians who answered questions on the use of digital health technology, and all the variables used in the analysis. The estimates are adjusted for the cross-sectional survey weights. The 95% Confidence Intervals (CI) presented in the parenthesis are based on standard errors clustered at the postcode level.

Estimates of the average marginal effects of using digital health technology on the probabilities of high job satisfaction and good work-life balance are shown in Table 4, with full results provided in Table A.2 and Table A.3 in the Appendix. Using digital health technology increased the probability of higher job satisfaction and having a good work-life balance in both unadjusted and adjusted models. After adjusting for endogeneity/confounding using an instrumental variable, the estimates were slightly smaller but still relatively large. The estimate of the average marginal effect on the probability of having high job satisfaction fell from 16.2 percentage points (95% CI, 0.112 to 0.212) in the adjusted analysis to 14.2 percentage points (95% CI, -0.013 to 0.297) in the instrumental variable analysis. The estimated effect on work-life balance fell from 23.2 percentage points (95% CI, 0.176 to 0.287) to 20.3 percentage points (95% CI, 0.024 to 0.381) in the instrumental variable analysis. The CIs were wider in the instrumental variable analysis, suggesting a higher level of uncertainty around the size of the effect of digital health technology on the two outcomes.

The Wald statistics for testing exogeneity of the instrumental variable were 23.99 and 15.11 from the analysis for job satisfaction and work-life balance, respectively. The p-values for both statistics were smaller than 0.001, suggesting the instrumental variable's validity by rejecting the null hypothesis of a non-zero correlation between the instrumental variable and the error terms in the models.

Table 4: Estimated average marginal effect on the probability of high job satisfaction and good work-life balance from using digital health technology

Model	Estimated average marginal effect on the probability (95% CI)
Job satisfaction	
Unadjusted analysis	0.174 (0.102,0.246)
Adjusted analysis	0.162 (0.112,0.212)
- General Practitioners only	0.246 (0.180,0.313)
- Specialists only	0.107 (0.021,0.193)
- Physician in training only	0.080 (-0.038,0.198)
Adjusted IV analysis	0.142 (-0.013,0.297)
p-value of Wald test of exogeneity < 0.001	
Work-life balance	
Unadjusted analysis	0.283 (0.198,0.367)
Adjusted analysis	0.232 (0.176,0.287)
- General Practitioner only	0.213 (0.125,0.301)
- Specialist only	0.176 (0.086,0.2767
- Physician in training only	0.194 (0.075,0.312)
Adjusted IV analysis	0.203 (0.024,0.381)
p-value of Wald test of exogeneity < 0.001	

Note: This table presents the estimated average marginal change in the probability of high job satisfaction and good work-life balance from using digital health technology. Each estimate is from a separate probit regression model that includes a full set of covariates from Table 2. All the adjusted estimates include the state the practice is located and the physicians' personality traits. The estimates for the specialists are adjusted for their specialties. The study sample includes 7,043 physicians who answered questions on the use of digital health technology, and all the variables used in the analysis. All the estimates are also adjusted for the cross-sectional survey weights. The

95% Confidence Intervals (CI) presented in the parenthesis are based on standard errors clustered at the postcode level. Detailed estimates are shown in Table A.2 and Table A.3 in the Appendix.

4 Discussion

In this nationally representative study of 7,043 Australian physicians, positive beliefs about the effect of digital health technology on improving the care process and having colleagues who use digital health technology had the strongest association with the use of digital health technology, followed by having IT support, and lack of privacy concerns. There was a strong association between the use of digital health technology and high job satisfaction and good work-life balance. The largest effects were for general practitioners, followed by specialists and physicians in training. These positive associations persisted after controlling for physicians' practice and personal characteristics, including their personality traits, and using an instrumental variable to adjust for the bias dues to reverse causality and unobservable confounders.

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,[8,27,28] other studies show that it does not or provide inconclusive results.[4–7,9] 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.[11] 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.

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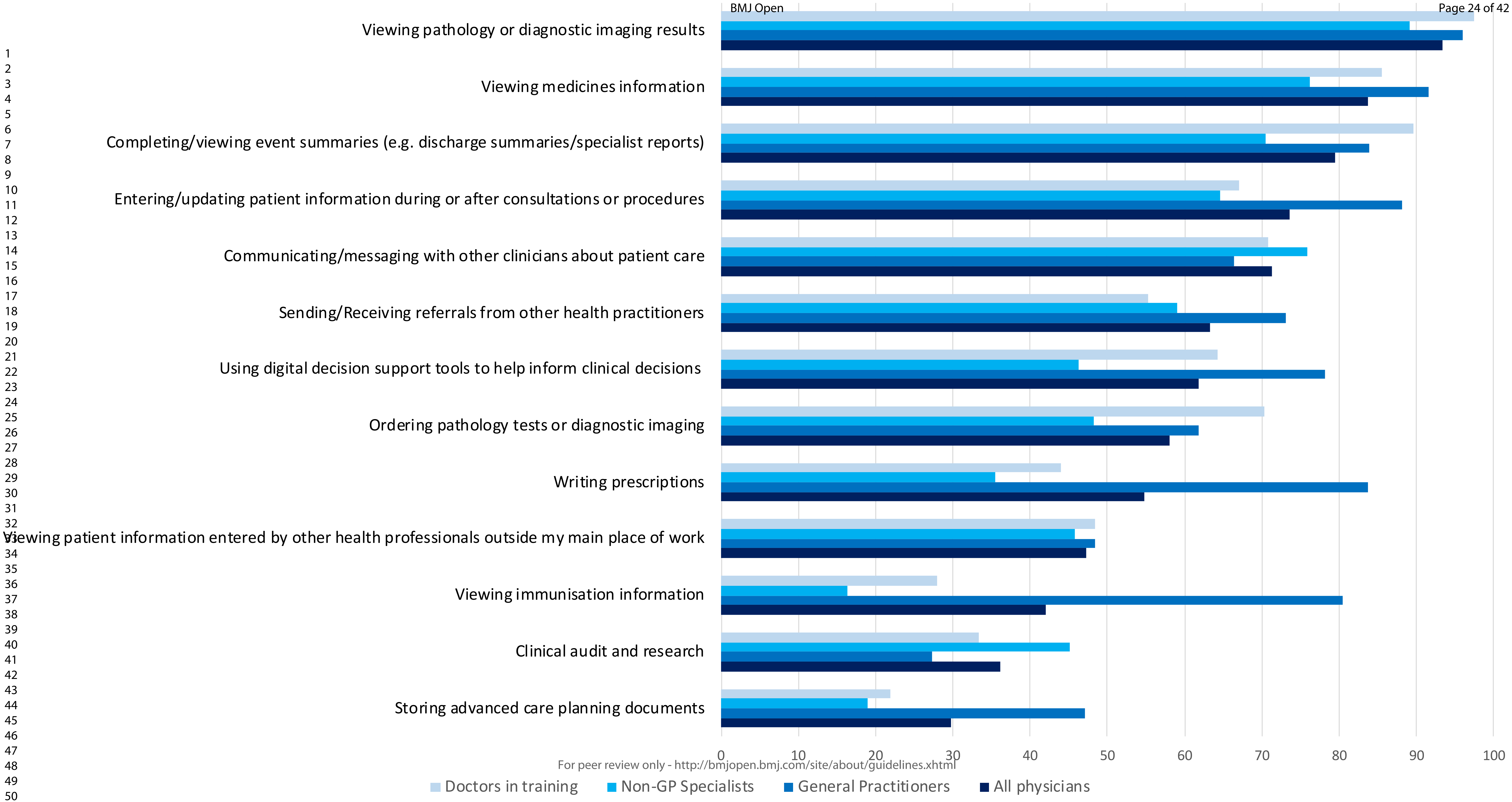
Contributorship statement

- AZ conducted the literature search, statistical analysis and contributed to data interpretation and drafting of the manuscript.
- AS provided management oversight of the project and contributed to data interpretation and drafting of the manuscript.


Viewing pathology or diagnostic imaging results
Viewing medicines information
Completing/viewing event summaries (e.g. discharge summaries/specialist reports)
Entering/updating patient information during or after consultations or procedures
Communicating/messaging with other clinicians about patient care
Sending/Receiving referrals from other health practitioners
Using digital decision support tools to help inform clinical decisions
Ordering pathology tests or diagnostic imaging
Writing prescriptions
Viewing patient information entered by other health professionals outside my main place of work
Viewing immunisation information
Clinical audit and research
Storing advanced care planning documents
0
10
20
30
40
50
60
70
80
90
100
Doctors in training
Non-GP Specialists
General Practitioners
All physicians

Appendix: Regressions

Table A.1: Estimated effects on the use of digital health technology

	Average marginal effect on the probability of using digital health technology probit (95% CI)
Colleagues and support staff already extensively use digital health technology	0.041
	(0.026,0.056)
Digital health technology improves care processes (e.g. improve care coordination, continuity of care and reduce duplication)	0.038
	(0.027,0.050)
I have no concerns about data privacy or security	0.005
	(0.001,0.010)
I receive support and advice on IT security from my main place of work (e.g., on password protection/ encryption, staff training, firewalls, and back-ups)	0.016
	(0.010,0.023)
Productivity	
Specialists	-0.002
	(-0.006,0.002)
Physician in training	-0.004
	(-0.012,0.003)
Male	0.003
	(-0.000,0.007)
Age: 40-49 years	0.011
	(0.005,0.018)
Age: 50-59 years	0.007
	(0.001,0.014)
Age: +60 years	-0.003
	(-0.012,0.006)
Live in partner	0.015
	(0.005,0.026)
Young child	-0.009
	(-0.017,-0.001)
Spouse: Full time employment	0.002
	(-0.004,0.008)
Spouse: Part time employment	0.007
	(0.001,0.013)
Practice setting: Public only	0.030
	(0.018,0.042)
Practice setting: Private only	0.021
	(0.012,0.031)
Metropolitan area	0.002
	(-0.003,0.007)
Socio-Economic Indexes for Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD)	-0.013
	(-0.037,0.010)
Foreign graduate	-0.007

	(-0.015,-0.000)
Top eight Australian university graduate	-0.005
	(-0.010,-0.000)
Fellowship of college	0.000
	(-0.004,0.005)
Personality trait: Extraversion	-0.001
	(-0.004,0.001)
Personality trait: Agreeableness	-0.000
	(-0.002,0.002)
Personality trait: Consciousness	0.001
	(-0.001,0.003)
Personality trait: Neuroticism	0.002
	(-0.000,0.004)
Personality trait: Openness	-0.000
	(-0.002,0.001)
State	Yes
Pseudo R2	0.464
Number of observations	7,043

Note: This table presents the estimated average marginal change in the probability of job satisfaction, work-life balance from using digital health technology. Each estimate is from a separate probit regression model that includes a full set of covariates from Table 2. All the adjusted estimates include the state the practice is located and the physicians' personality traits. The estimates for the specialists are adjusted for their specialties. All the estimates are also adjusted for the cross-sectional survey weights. The 95% Confidence Intervals (CI), presented in the parenthesis are based on standard errors clustered at the postcode level.

Table A.2: Estimated average marginal effects of using digital health technology on the probability of high job satisfaction

Models	Probit - All physicians	IV-Probit - All physicians	Probit - GPs	Probit - Specialists	Probit - Doctors in training
Using digital health technology	0.162	0.142	0.246	0.107	0.080
	(0.112,0.212)	(-0.013,0.297)	(0.180,0.313)	(0.021,0.193)	(-0.038,0.198)
Specialists	0.098	0.107			
	(0.060,0.136)	(0.068,0.145)			
Physician in training	-0.032	-0.027			
	(-0.085,0.020)	(-0.079,0.025)			
Male	0.007	0.007	-0.024	0.010	0.040
	(-0.022,0.035)	(-0.022,0.036)	(-0.074,0.026)	(-0.038,0.059)	(-0.007,0.088)
Age: 40-49 years	-0.046	-0.042	0.001	-0.091	-0.028
	(-0.088,-0.004)	(-0.086,0.002)	(-0.066,0.067)	(-0.165,-0.017)	(-0.119,0.064)
Age: 50-59 years	-0.030	-0.025	0.020	-0.074	0.109
	(-0.081,0.021)	(-0.077,0.027)	(-0.046,0.086)	(-0.156,0.009)	(-0.046,0.265)
Age: +60 years	0.080	0.090	0.088	0.046	0.203
	(0.027,0.134)	(0.036,0.144)	(0.019,0.157)	(-0.042,0.134)	(-0.022,0.428)
Live in partner	0.073	0.073	0.059	0.047	0.092
	(0.035,0.112)	(0.033,0.113)	(-0.006,0.125)	(-0.017,0.111)	(0.038,0.146)
Young child	-0.070	-0.069	-0.062	-0.103	-0.039
	(-0.111,-0.029)	(-0.111,-0.027)	(-0.135,0.012)	(-0.171,-0.036)	(-0.100,0.022)
Spouse: Full-time employment	-0.024	-0.024	-0.029	-0.024	-0.044
	(-0.059,0.011)	(-0.060,0.011)	(-0.084,0.027)	(-0.077,0.029)	(-0.109,0.020)
Spouse: Part-time employment	-0.055	-0.054	-0.029	-0.064	-0.079
	(-0.095,-0.015)	(-0.094,-0.013)	(-0.088,0.031)	(-0.121,-0.006)	(-0.156,-0.002)
Practice setting: Public only	-0.011	-0.017	0.065	0.000	0.102
	(-0.046,0.023)	(-0.059,0.025)	(-0.057,0.187)	(-0.044,0.045)	(0.026,0.178)
Practice setting: Private only	0.132	0.130	0.114	0.149	0.256
	(0.089,0.176)	(0.083,0.176)	(0.056,0.172)	(0.089,0.210)	(0.072,0.439)
Metropolitan area	-0.068	-0.067	-0.099	-0.027	-0.089
	(-0.107,-0.030)	(-0.106,-0.028)	(-0.151,-0.046)	(-0.093,0.040)	(-0.165,-0.013)
Socio-Economic Indexes for Areas of Relative Socio-economic Advantage and Disadvantage	0.118	0.116	0.213	0.052	-0.073

(SEIFA-IRSAD)					
	(-0.105,0.341)	(-0.111,0.343)	(-0.112,0.539)	(-0.297,0.401)	(-0.428,0.282)
Foreign graduate	-0.007	-0.012	-0.081	0.038	-0.031
	(-0.048,0.033)	(-0.052,0.028)	(-0.143,-0.019)	(-0.021,0.096)	(-0.114,0.052)
Top eight Australian university graduate	0.018	0.016	-0.008	0.042	-0.023
	(-0.021,0.057)	(-0.023,0.055)	(-0.065,0.048)	(-0.014,0.098)	(-0.082,0.036)
Fellowship of college	0.045	0.047	0.051	0.050	-0.015
	(0.008,0.083)	(0.010,0.084)	(0.007,0.094)	(-0.032,0.132)	(-0.130,0.099)
Personality trait: Extraversion	0.093	0.093	0.103	0.102	0.073
	(0.077,0.109)	(0.077,0.110)	(0.078,0.128)	(0.079,0.125)	(0.045,0.102)
Personality trait: Agreeableness	0.027	0.025	0.031	0.026	0.027
	(0.010,0.043)	(0.008,0.041)	(0.006,0.055)	(0.001,0.051)	(0.001,0.053)
Personality trait: Consciousness	0.008	0.008	0.006	0.011	-0.005
	(-0.006,0.022)	(-0.006,0.022)	(-0.017,0.028)	(-0.011,0.033)	(-0.029,0.018)
Personality trait: Neuroticism	-0.000	-0.000	0.009	-0.005	0.005
	(-0.014,0.014)	(-0.014,0.014)	(-0.013,0.032)	(-0.027,0.018)	(-0.018,0.027)
Personality trait: Openness	-0.016	-0.016	-0.019	-0.020	-0.017
	(-0.031,-0.002)	(-0.030,-0.001)	(-0.043,0.005)	(-0.042,0.001)	(-0.039,0.005)
Wald statistics for exogeneity test [p-value]		23.990 [0.000]			
State	Yes	Yes	Yes	Yes	Yes
Specialty	No	No	No	Yes	No
Pseudo R2	0.075	0.225	0.072	0.082	0.069
Number of observations	7,043	7,043	2,491	2,776	1,651

Note: This table presents the estimated average marginal change in the probability of job satisfaction, work-life balance from using digital health technology. Each estimate is from a separate probit regression model that includes a full set of covariates from Table 2. All the adjusted estimates include the state the practice is located and the physicians' personality traits. The estimates for the specialists are adjusted for their specialties. All the estimates are also adjusted for the cross-sectional survey weights. The 95% Confidence Intervals (CI), presented in the parenthesis are based on standard errors clustered at the postcode level.

Table A.3: Estimated average marginal effects of using digital health technology on the probability of work-life balance

Models	Probit - All physicians	IV-Probit - All physicians	Probit - GPs	Probit - Specialists	Probit - Doctors in training
Using digital health technology	0.232	0.203	0.213	0.176	0.194
	(0.176,0.287)	(0.024,0.381)	(0.125,0.301)	(0.086,0.267)	(0.075,0.312)
Specialists	0.122	0.129			
	(0.081,0.164)	(0.088,0.171)			
Physician in training	-0.078	-0.074			
	(-0.136,-0.021)	(-0.133,-0.016)			
Male	0.008	0.009	-0.053	0.009	0.047
	(-0.025,0.042)	(-0.025,0.043)	(-0.104,-0.002)	(-0.039,0.057)	(-0.003,0.097)
Age: 40-49 years	-0.072	-0.068	-0.089	-0.104	0.015
	(-0.116,-0.028)	(-0.112,-0.024)	(-0.156,-0.023)	(-0.167,-0.042)	(-0.088,0.118)
Age: 50-59 years	-0.047	-0.042	-0.039	-0.090	0.196
	(-0.096,0.001)	(-0.089,0.005)	(-0.106,0.027)	(-0.159,-0.021)	(0.031,0.361)
Age: +60 years	0.041	0.050	0.048	0.005	0.166
	(-0.008,0.090)	(0.001,0.099)	(-0.018,0.115)	(-0.067,0.077)	(-0.056,0.388)
Live in partner	0.094	0.094	0.037	0.103	0.045
	(0.053,0.135)	(0.047,0.140)	(-0.028,0.102)	(0.033,0.173)	(-0.024,0.115)
Young child	-0.098	-0.097	-0.031	-0.134	-0.117
	(-0.145,-0.051)	(-0.148,-0.046)	(-0.105,0.044)	(-0.213,-0.054)	(-0.195,-0.039)
Spouse: Full-time employment	-0.037	-0.038	-0.028	-0.052	0.000
	(-0.073,-0.001)	(-0.073,-0.002)	(-0.084,0.028)	(-0.107,0.003)	(-0.070,0.070)
Spouse: Part-time employment	-0.033	-0.031	0.010	-0.059	0.011
	(-0.076,0.011)	(-0.076,0.014)	(-0.051,0.070)	(-0.115,-0.003)	(-0.119,0.142)
Practice setting: Public only	0.087	0.082	0.221	0.078	0.123
	(0.046,0.127)	(0.030,0.133)	(0.086,0.357)	(0.026,0.131)	(0.035,0.211)
Practice setting: Private only	0.204	0.201	0.207	0.183	0.397
	(0.161,0.248)	(0.151,0.251)	(0.147,0.268)	(0.129,0.237)	(0.198,0.596)
Metropolitan area	0.005	0.006	0.047	-0.002	-0.040
	(-0.036,0.045)	(-0.034,0.047)	(-0.006,0.100)	(-0.069,0.065)	(-0.114,0.034)
Socio-Economic Indexes for Areas of	-0.182	-0.187	0.029	-0.236	-0.222

Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD)					
	(-0.455,0.090)	(-0.463,0.088)	(-0.305,0.363)	(-0.656,0.184)	(-0.659,0.214)
Foreign graduate	0.016	0.012	-0.045	0.066	0.023
	(-0.025,0.057)	(-0.029,0.052)	(-0.112,0.022)	(0.010,0.123)	(-0.080,0.126)
Top eight Australian university graduate	0.048	0.046	-0.012	0.079	0.025
	(0.010,0.086)	(0.008,0.084)	(-0.071,0.047)	(0.020,0.139)	(-0.040,0.090)
Fellowship of college	0.034	0.036	0.039	0.057	-0.090
	(-0.005,0.073)	(-0.003,0.075)	(-0.009,0.086)	(-0.022,0.136)	(-0.198,0.018)
Personality trait: Extraversion	0.064	0.064	0.039	0.069	0.081
	(0.050,0.079)	(0.049,0.079)	(0.014,0.065)	(0.048,0.090)	(0.050,0.112)
Personality trait: Agreeableness	0.010	0.008	-0.014	0.016	0.025
	(-0.006,0.025)	(-0.008,0.023)	(-0.037,0.010)	(-0.005,0.037)	(-0.005,0.055)
Personality trait: Consciousness	-0.009	-0.010	-0.005	-0.007	-0.023
	(-0.025,0.006)	(-0.025,0.006)	(-0.026,0.017)	(-0.028,0.014)	(-0.053,0.007)
Personality trait: Neuroticism	-0.011	-0.011	-0.005	-0.014	-0.007
	(-0.025,0.003)	(-0.025,0.003)	(-0.028,0.017)	(-0.036,0.008)	(-0.035,0.020)
Personality trait: Openness	-0.044	-0.043	-0.035	-0.044	-0.037
	(-0.059,-0.028)	(-0.059,-0.027)	(-0.059,-0.010)	(-0.066,-0.022)	(-0.063,-0.012)
Wald statistics for exogeneity test [p-value]		15.110 [0.000]			
State	Yes	Yes	Yes	Yes	Yes
Specialty	No	No	No	Yes	No
Pseudo R2	0.021	0.217	0.062	0.070	0.068
Number of observations	7,043	7,043	2,491	2,776	1,651

Note: This table presents the estimated average marginal change in the probability of job satisfaction, work-life balance from using digital health technology. Each estimate is from a separate probit regression model that includes a full set of covariates from Table 2. All the adjusted estimates include the state the practice is located and the physicians' personality traits. The estimates for the specialists are adjusted for their specialties. All the estimates are also adjusted for the cross-sectional survey weights. The 95% Confidence Intervals (CI), presented in the parenthesis are based on standard errors clustered at the postcode level.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	Does Digital Health Technology Improve Physicians' Job Satisfaction and Work-life Balance? A Cross-Sectional National Survey and Regression Analysis Using Instrumental Variable
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1, 2	**Objectives** To examine the association between physicians' use of digital health technology and their job satisfaction and work-life balance. **Design** A cross-sectional nationally representative survey of physicians and probit regression models were used to examine the association between using digital health technology and the probability of reporting high job satisfaction and a good work-life balance. Models included a rich set of covariates, including physicians' personality traits, and instrumental variable analysis was used to control for bias from unobservable confounders and reverse causality. **Setting** Clinical practice settings in Australia, including physicians working in primary care, hospitals, outpatient settings, and physicians working in the public and private sectors. **Participants** Respondents to Wave 11 (2018-19) of the Medicine in Australia: Balancing Employment and Life (MABEL) longitudinal survey of doctors. The analysis sample included a broadly nationally representative sample of 7,043 physicians, including General Practitioners (GPs), non-GP specialists, and physicians in training. **Primary and secondary outcome measures** The proportion of respondents who used any digital health technology; proportion moderately or very satisfied with their job overall; proportion agreeing or strongly agreeing to the statement on work-life balance: 'the balance between personal and professional commitments is about right.' **Results**

				Physicians with positive beliefs about the effectiveness of using digital health technology were 3.8 (95% Confidence Interval (CI), 2.7 to 5.0) Percentage Points (PP) more likely to use digital health technology compared with those who did not. Physicians with colleagues who already used digital health technology were also 4.1 (95% CI, 2.6 to 5.6) PP more likely to use digital health technology. The availability of IT support and lack of privacy concerns increased the probability of using digital health technology by 1.6 (95% CI, 1.0 to 2.3) and 0.5 (95% CI, 0.1 to 1.0) PP. Physicians who used digital health technology were 14.2 (95% CI, -1.3 to 29.7) and 20.3 (95% CI, 2.4 to 38.1) PP more likely to report respectively higher job satisfaction and good work-life balance, compared with the physicians who did not use it. **Conclusions** Findings suggested digital health technology served more as a work resource than work demand for physicians who used it.
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	Digital health technology, such as shared electronic health records, can improve information flow between healthcare providers and between providers and patients. Figure 1 shows the activities which for Australian physicians use digital health technology. Convincing busy physicians to use digital health technology in their practice requires evidence on the benefits to patients and evidence on the benefits and costs to the physicians themselves. There is a potential for digital health technology to save physicians' time by accessing patients' medical records, test results, and medication information more quickly. Through sharing more standard information and making such information available at the point of care, digital health technology can reduce duplication of tests, reduce medication errors, and improve patient safety. However, digital health technology can also be an additional work demand as extra time is needed to input patients' health information into the electronic record and read and interpret the other healthcare providers' information. The net impact of these factors influences whether physicians choose to use digital health technology.
Objectives	3	State specific objectives, including any prespecified hypotheses	5, 6	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,5 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. In ambulatory and primary care, a recent survey showed an association with the use of electronic medical records and 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.

				This paper aims to examine the factors associated with the uptake of digital health technology by physicians and then examine the association between the use of digital health technology and physicians' job satisfaction and work-life balance.
Methods				
Study design	4	Present key elements of study design early in the paper	11	Descriptive statistics of all variables were presented. Differences between physicians who used digital health technology and those who did not were tested using two-sided t-tests for the means and proportions. Multivariate probit regressions were used, given the binary nature of the outcome variables, the use of instrumental variables estimation, and the ease of interpreting results as changes in proportions. The first model included the use of digital health technology as the dependent variable to examine the association between using digital health technologies with physicians' beliefs about its effectiveness, peer effects, IT support and privacy concerns, and physicians' characteristics.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8	The 11th wave of the MABEL questionnaire was sent to 27,829 physicians in August 2018. This included 17,103 physicians who had previously responded to the earlier waves, 4,525 who were new to the sample frame, and 4,698 from a 10% boost sample of physicians who previously never responded.
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria,	12	*Cross-sectional study*— The sample used in Table 1 included 7,043 respondents working in clinical practice and answered the digital health technologies questions and all the other questions used in the analysis. Of the 7,043 physicians, 6,537 physicians (92.82%) used digital health technology, where 35.4% were general practitioners (19.6% used digital health technology), 41.2% were other specialists (61.9% users). The remaining 23.4% were physicians in training (18.7% users).

		and the sources and methods of selection of participants		
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case		NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable		**2.2 Source of data** The Medicine in Australia: Balancing Employment and Life (MABEL) survey is an annual longitudinal survey of around 10,000 physicians in clinical practice focusing on workforce participation, labor supply, and its determinants. The survey is representative of the physicians' population in Australia and provides information on physicians' characteristics, family circumstances, geographic location, qualifications, and practice settings. The first wave of MABEL was conducted in 2008, where the population of 54,750 physicians in clinical practice in Australia were invited to participate in the survey. The 10,498 doctors who participated in the baseline cohort were representative of the physicians' population in Australia in 2008 with respect to age, gender, and geographic location. In each subsequent wave, a new cohort of physicians were invited to participate in the survey in addition to all those who participated in the survey in the previous waves. A paper copy of the survey questionnaire and online login information was mailed to the physicians' work address, followed by three reminders for each wave. Physicians in rural areas received an AUD100 cheque along with the invitation to participate in the survey. **2.3 Study population** The 11th wave of the MABEL questionnaire was sent to 27,829 physicians in August 2018. This included 17,103 physicians who had previously responded to the earlier waves, 4,525 who were new to the sample frame, and 4,698 from a ten percent boost sample of physicians who previously never responded. **2.3.1 Digital health technology** 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 technologies 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 Figure 1.

The survey also asked physicians about their attitudes and beliefs around digital health technology. These questions were developed in collaboration with the Australian Digital Health Agency based on previous surveys and literature. The questions covered four main areas of attitudes and beliefs that were hypothesized to influence uptake: effectiveness of digital health technology, data sharing and privacy concerns, peer effects, and the 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."

2.3.2 Job satisfaction and work-life balance

Job satisfaction was measured using the 10-item short version of the Warr-Cook-Wall Job Satisfaction Scale.20,21 This was validated in the MABEL cohort of Australian clinical medical practitioners. Overall job satisfaction was coded as a binary variable equal to one for respondents who answered "moderately satisfied" or "very satisfied" to the question asking: "Taking everything into account, how do you feel about your work." Work-life balance was defined as a binary variable equal to one for respondents who answered "agree" or "strongly agree" to the question asking: "The balance between my personal and professional commitments is about right."

2.3.3 Other variables

The analyses included several control variables that have been shown to influence job satisfaction and work-life balance: gender, age, marital status (single as the base, living in with a partner), spouse employment status (unemployed or not applicable as the base, full time or part-time), having at least one child below five years old, geographic location including whether in a metropolitan area, state, and socio-economic status of the postcode measured by the Socio-Economic Indexes For Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD). This index is constructed by the Australian Bureau of Statistics based on information from the

				five-yearly Census. A low score indicates a relatively greater disadvantage and a lack of advantage, and a high score indicates a relative lack of disadvantage and greater advantage. Other variables included whether the physician worked in the public, private, or both public and private sectors, whether they were an overseas trained physician, whether they graduated from one of the top-eight Australian medical schools, and whether they held a fellowship of their college. Also, personality traits were measured using the 15-item factor model. The big-five personality traits included in the models were extraversion, agreeableness, conscientiousness, neuroticism, and openness, and were standardized to have a mean of zero and standard deviation of one.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group		NA
Bias	9	Describe any efforts to address potential sources of bias	16	After adjusting for endogeneity/confounding using an instrumental variable, the estimates were slightly smaller but still relatively large. The estimate of the average marginal effect on the probability of having high job satisfaction fell from 16.2 (95% CI, 0.112 to 0.212) in the adjusted analysis to 14.2 percentage points (95% CI, -0.013 to 0.297) in the instrumental variable analysis. The estimated effect on work-life balance fell from 23.2 (95% CI, 0.176 to 0.287) to 20.3 percentage points (95% CI, 0.024 to 0.381) in the instrumental variable analysis. The CIs were wider in the instrumental variable analysis, suggesting a higher level of uncertainty around the size of the effect of digital health technology on the two outcomes. The goodness of fit of the models was higher when the instrumental variable was used. The Wald statistics for testing exogeneity of the instrumental variable were 23.99 and 15.11 from the analysis for job satisfaction and work-life balance, respectively. The p-values for both statistics were <0.001, suggesting the instrumental variable's validity by rejecting the null hypothesis of a non-zero correlation between the instrumental variable and the error terms in the models.
Study size	10	Explain how the study size was arrived at	12	The sample used in Table 1 included 7,043 respondents working in clinical practice and answered the digital health technologies questions and all the other questions used in the analysis.

Quantitative variables	11	Explain how quantitative variables were handled in	9, 10	The survey also asked physicians about their attitudes and beliefs around digital health technology. These questions were developed in collaboration with the Australian Digital Health Agency based on previous surveys and literature. The questions covered four main areas of attitudes and beliefs that were hypothesized to

		the analyses. If applicable, describe which groupings were chosen and why		influence uptake: effectiveness of digital health technology, data sharing and privacy concerns, peer effects, and the 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." Job satisfaction was measured using the 10-item short version of the Warr-Cook-Wall Job Satisfaction Scale. This was validated in the MABEL cohort of Australian clinical medical practitioners. Overall job satisfaction was coded as a binary variable equal to one for respondents who answered "moderately satisfied" or "very satisfied" to the question asking: "Taking everything into account, how do you feel about your work." Work-life balance was defined as a binary variable equal to one for respondents who answered "agree" or "strongly agree" to the question asking: "The balance between my personal and professional commitments is about right." The analyses included several control variables that have been shown to influence job satisfaction and work-life balance: gender, age, marital status (single as the base, living in with a partner), spouse employment status (unemployed or not applicable as the base, full time or part-time), having at least one child below five years old, geographic location including whether in a metropolitan area, state, and socio-economic status of the postcode measured by the Socio-Economic Indexes For Areas of Relative Socio-economic Advantage and Disadvantage (SEIFA-IRSAD). This index is constructed by the Australian Bureau of Statistics based on information from the five-yearly Census. A low score indicates a relatively greater disadvantage and a lack of advantage, and a high score indicates a relative lack of disadvantage and greater advantage. Other variables included whether the physician worked in the public, private, or both public and private sectors, whether they were an overseas trained physician, whether they graduated from one of the top-eight Australian medical schools, and whether they held a fellowship of their college. Also, personality traits were measured using the 15-item factor model. The big-five personality traits included in the models were extraversion, agreeableness, conscientiousness, neuroticism, and openness, and were standardized to have a mean of zero and standard deviation of one.
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11	Multivariate probit regressions were used, given the binary nature of the outcome variables, the use of instrumental variables estimation, and the ease of interpreting results as changes in proportions. The first model included the use of digital health technology as the dependent variable to examine the association between using digital health technologies with physicians' beliefs about its effectiveness, peer effects, IT support and privacy concerns, and physicians' characteristics. The second and third probit models used job satisfaction and work-life balance as outcome variables to examine the association with the use of digital health technology. Although a rich set of control variables were included,

				there may be unobserved confounding factors correlated with the decision to use digital health technology. Further, these models might suffer from reverse causality (simultaneity) where physicians with higher job satisfaction or good work-life balance might also be more likely to use digital health technology, resulting in an overestimation of the size of the association from the probit models. To adjust for these potential biases, probit models with an instrumental variable were estimated using a maximum likelihood method. An instrumental variable is an observable factor related to physicians' choice of using digital health technology, but unrelated to their work satisfaction or work-life balance. We used physicians' beliefs about digital health technology's effectiveness for improving the care process as an instrumental variable for using digital health technology since it had the strongest association with the use of digital health technology from our first model. The Wald statistics were constructed to test the exogeneity of the instrumental variable, whether it was correlated with the error term of the job satisfaction and work-life balance probit models, which is a required condition for the validity of the analysis.
		(*b*) Describe any methods used to examine subgroups and interactions		NA
		(*c*) Explain how missing data were addressed		NA
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy		NA
		(*e*) Describe any sensitivity analyses		NA
Results				
Participants	13*	(a) Report numbers of individuals at each stage of	12	The sample used in Table 1 included 7,043 respondents working in clinical practice and answered the digital health technologies questions and all the other questions used in the analysis. Of the 7,043 physicians, 6,537

		study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed		physicians (92.82%) used digital health technology, where 35.4% were general practitioners (19.6% used digital health technology), 41.2% were other specialists (61.9% users). The remaining 23.4% were physicians in training (18.7% users).
		(b) Give reasons for non-participation at each stage		NA
		(c) Consider use of a flow diagram		NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders		NA
		(b) Indicate number of participants with missing data for each variable of interest		NA
		(c) *Cohort study*—Summarise follow-up time (e.g., average and total amount)	14	Table 1 compares the characteristics of physicians who used digital health technology with those who did not. Physicians who used digital health technology were older, more likely to be male, more likely to have a live-in partner, who was also more likely to be employed (either part-time or full-time). Users were more likely to hold fellowship of their college, and more likely to work either solely in public or private practice than doctors working across both settings. There were no differences in the personality traits between physicians who used and did not use digital health technologies. Most of the physicians who used digital health technology had positive beliefs about digital health technology's effectiveness in improving the care process, had colleagues who also used it, had IT support in their practice, and had no privacy concerns. The users also were more likely to be satisfied with their job and have a good work-life balance.
Outcome data	15*	*Cohort study*—Report numbers of outcome events		NA

		or summary measures over time		
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		NA
		Cross-sectional study—Report numbers of outcome events or summary measures	14	The users also were more likely to be satisfied with their job and have a good work-life balance.
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15, 16	Estimates of the average marginal effects of using digital health technology on the probabilities of high job satisfaction and good work-life balance are shown in Table 3. Using digital health technology increased the probability of higher job satisfaction and having better work-life balance in both unadjusted and adjusted models. After adjusting for endogeneity/confounding using an instrumental variable, the estimates were slightly smaller but still relatively large. The estimate of the average marginal effect on the probability of having high job satisfaction fell from 16.2 (95% CI, 0.112 to 0.212) in the adjusted analysis to 14.2 percentage points (95% CI, -0.013 to 0.297) in the instrumental variable analysis. The estimated effect on work-life balance fell from 23.2 (95% CI, 0.176 to 0.287) to 20.3 percentage points (95% CI, 0.024 to 0.381) in the instrumental variable analysis. The CIs were wider in the instrumental variable analysis, suggesting a higher level of uncertainty around the size of the effect of digital health technology on the two outcomes. The goodness of fit of the models was higher when the instrumental variable was used. The Wald statistics for testing exogeneity of the instrumental variable were 23.99 and 15.11 from the analysis for job satisfaction and work-life balance, respectively. The p-values for both statistics were <0.001, suggesting the instrumental variable's validity by rejecting the null hypothesis of a non-zero correlation between the instrumental variable and the error terms in the models.
		(*b*) Report category boundaries when continuous variables were categorized		NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute		NA

		risk for a meaningful time period		
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	14, 15	The estimates of average marginal effects from the factors associated with the probability of using digital health technology are shown in Table 2, with full results provided in Table A.3 in the Appendix. After adjusting for the variables presented in Table 1, positive beliefs about the effectiveness of digital health technology for improving the care process and having colleagues who use digital health technology in their practice were associated with an increase in the probability of using digital health technology of 3.8 (95% CI, 0.027 to 0.050) and 4.1 (95% CI, 0.026 to 0.056) percentage points, respectively. Availability of IT support (1.6 percentage points: 95% CI, 0.010 to 0.023) and lack of privacy concerns (0.5 percentage points; 95% CI, 0.001 to 0.010) were also associated with increased probability of uptake. Respondents aged between 40 and 59 were more likely to use digital health technology than those below 40 years old, but the effects were relatively small. Physicians with live-in partners who worked part-time compared to not working, physicians working in public or private practice only, compared to working in both sectors, were also more likely to use digital health technology. Lower uptake was more likely for physicians with young children, those who graduated overseas, graduates from a top Australian university, and physicians with the primary location of practice in the areas with lower socioeconomic status, though these effects were small. The association between the uptake of digital health technology and physicians' big-five personality traits were relatively weak.
Discussion				
Key results	18	Summarise key results with reference to study objectives	17	In this nationally representative study of 7,043 Australian physicians, positive beliefs about the effect of digital health technology on improving the care process and having colleagues who use digital health technology had the strongest association with the use of digital health technology, followed by having IT support, and lack of privacy concerns. There was a strong association between the use of digital health technology and job satisfaction and work-life balance. The largest effects were for general practitioners, followed by specialists and physicians in training. These positive associations persisted after controlling for physicians' practice and personal characteristics, including their personality traits, and using an instrumental variable to adjust for the bias dues to reverse causality and unobservable confounders.
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both	18	A limitation of this study was that the results were based on a cross-sectional survey. 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 biased due to reverse causality issues and confounding factors. There still could be other unobserved factors that were not controlled for, requiring a cautious interpretation of the findings.

		direction and magnitude of any potential bias		A further limitation 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 which were not included in the analysis, including the mix of public and private funding for different types of healthcare providers. GPs 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 also help the more efficient design of policies to increase the use of digital health technologies 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 are more likely to use digital health technology than those who work across both sectors and show that peer effects matter.
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17, 18	Previous research has produced mixed results on the effects of using digital health technology on various aspects of physicians' work, showing that it benefits some aspects of physicians' work, and other studies showing that it does not or provide mixed results. The mixed findings could be due to either the statistical method or the studies' data. 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 include a rich set of information on the physicians, including their personality characteristics. Further, we used an instrumental variable model to correct statistical issues such as biases due to reverse causality and omitted variables. The results of this study suggested that digital health technology served more as a work resource for physicians rather than a work demand.
Generalisability	21	Discuss the generalisability (external validity) of the study results	18	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 uptake should focus on persuading them of the benefits of using digital health technology, colleagues' use, and ensuring sufficient IT support.
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3	This research was funded by the Australian Digital Health Agency. We used data from the Medicine in Australia: Balancing Employment and Life (MABEL) longitudinal survey. Funding for MABEL was provided by the National Health and Medical Research Council (2007–2016: 454799 and 1019605); the Australian Government Department of Health and Ageing (2008); Health Workforce Australia (2013); and in 2017 The University of Melbourne, Medibank Better Health Foundation, New South Wales Department of Health, and Victorian Department of Health and Human Services. In 2018, MABEL was funded by the Australian Government Department of Health, Victorian Department of Health and Human Services, and Australian Digital Health Agency. The study was approved by The University of Melbourne Faculty of Business and Economics Human Ethics Advisory Group (Ref: 0709559) and the Monash University Standing Committee on Ethics in Research Involving Humans (Ref: CF07/1102–2007000291).

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.