Primary care physician eHealth profile, healthcare coordination, and burnout : insights from cross-sectional studies

Doctoral Thesis in Medicine (MD)

Mathieu Jendly

University of Fribourg (Switzerland)
Faculty of Science and Medicine
Department of Public Health

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Faculty of Science and Medicine
Department of Community Health
Population Health Laboratory #PopHealthLab
University of Fribourg, Switzerland

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THESIS

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Co-director and supervising Professor at the Faculty of Science and Medicine:

Prof. Arnaud Chiolero

Professor at la Source, HES-SO University of Applied Sciences and Arts Western Switzerland and Co-director:

Prof. Valérie Santschi

Dean of the Faculty of Science and Medicine:

Prof. Michael Walch

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Summary

Background

Digital health refers to the implementation of information and communication technologies for health purposes. Numerous studies highlight its growing role, particularly in the management of chronic diseases and the promotion of patient autonomy. Patients are now able to share data with healthcare professionals in unprecedented ways. Digital health also offers professionals new opportunities for communication and transmission of health data, which support care coordination.

However, its adoption by healthcare professionals is hindered by several challenges, such as fears of disrupting the therapeutic relationship, concerns about data protection, and the additional administrative burden it may generate, especially with electronic medical records. This burden is frequently cited as a risk factor for burnout.

Aim of the thesis

This thesis aimed to assess the use of digital health tools by primary care physicians in Switzerland and 10 other OECD countries.

The first chapter, "*Primary care physician eHealth profile and care coordination: a cross-sectional study*", examined the relationship between digital health use and care coordination in Switzerland.

The second chapter, "*Primary care physician digital health profile and burnout: an international cross-sectional study*", explored the link between digital health use and burnout, along with related outcomes, in 10 OECD countries.

Methods

The Commonwealth Fund (CWF) is a U.S.-based non-profit organization that conducts the "International Health Policy (IHP) Survey" annually in various OECD countries, targeting either primary care physicians, the general adult population (18+), or adults aged 65 and over. These surveys aim to compare the performance of different health systems.

For both chapters of this thesis, we conducted a secondary analysis of the 2022 IHP survey, which focused on primary care physicians from ten OECD countries (Switzerland, Australia, Canada, France, Germany, the Netherlands, New Zealand, Sweden, the United Kingdom, and the United States). Data collection took place between February and September 2022.

We used data related to physicians' characteristics and their practice settings. To assess digital health use, we constructed a digital health score based on 10 questions concerning teleconsultation, use of connected health tools, electronic medical records, and various digital services offered to patients. Assigning each item a value of 0 or 1, we obtained a total score ranging from 0 to 10. We then described digital health use in Switzerland (chapter 1) and across the 10 OECD countries, comparing usage between them (chapter 2).

In the first chapter focusing on care coordination, we presented descriptive statistics and constructed a coordination score based on 5 questions regarding the presence of nurses or case managers to assist with chronic disease management, communication with specialists, and collaboration with home care and social services. Like the digital health score, each item was assigned a value of 0 or 1, leading to a score ranging from 0 to 5.

To assess the relationship between digital health use and care coordination, we performed linear regression analyses between the two scores, both unadjusted and adjusted for physician gender, age, specialization, and practice setting.

In the second chapter, we presented descriptive statistics on physician burnout and related outcomes such as perceived stress, satisfaction with daily workload, time spent on administrative tasks, and work-life balance. We then compared burnout prevalence across countries and used logistic regressions to assess associations between the digital health score and burnout, as well as related variables.

Results

The first chapter, which focused on digital health use and its association with care coordination in Switzerland, showed that digital tools were relatively underused in this country. For instance, 17% of physicians did not use electronic medical records, and 63% never used connected tools to monitor chronic conditions. Our results suggest a modest association between the digital health score and the care coordination score.

The second chapter described digital health use by primary care physicians in 10 OECD countries, assessed their levels of burnout and related outcomes, and explored the relationship between digital health use and burnout. Our results revealed substantial cross-country differences, both in digital health adoption and in burnout prevalence. The Netherlands, the United Kingdom, and New Zealand had the highest digital health scores, while Germany and Switzerland had the lowest. Overall, 35% of physicians reported experiencing burnout, with particularly high rates in New Zealand (49%) and Canada (46%), and lower rates in the Netherlands (12%) and Switzerland (18%).

We found no association between the digital health score and burnout, perceived stress, satisfaction with administrative workload, or work-life balance. However, a relationship was found between digital health use and dissatisfaction with daily workload.

Conclusion and implications

This thesis explored the use of digital health tools by primary care physicians in Switzerland and ten OECD countries, and examined their relationship with care coordination and burnout.

In Switzerland, the results indicate that digital health adoption remains limited, with low use of electronic medical records and connected tools for managing chronic diseases. A modest association was observed between higher digital health use and better care coordination.

At the international level, large differences emerged between countries in terms of digital health adoption and burnout prevalence. The Netherlands, the UK, and New Zealand had the highest digital health scores, while Germany and Switzerland had the lowest. No link was found between digital health use and burnout, perceived stress, or work-life balance. However, greater digital health use was associated with increased dissatisfaction with daily workload.

These findings suggest a potential synergy between digital transformation and care coordination. Based on our data, digital health did not appear to be associated with burnout among primary care physicians. However, its association with dissatisfaction regarding workload suggests that although digital tools are intended to support clinical practice, they may also increase workload and administrative complexity.

While digital health could be beneficial for patients, our findings highlight the need to optimize its implementation to ensure that it alleviates, rather than exacerbates, physicians' workload.

Summary (french version)

Contexte

La santé digitale désigne la mise en œuvre des technologies de l'information et de la communication à des fins de santé. De nombreuses études soulignent son rôle croissant, notamment dans la gestion des maladies chroniques et dans la promotion de l'autonomie du patient. Les patients ont alors la possibilité inédite de partager des données avec les professionnels de santé. La santé digitale offre également aux professionnels de nouvelles opportunités en matière de communication d'informations et de transmission des données de santé, favorables à la coordination des soins.

Cependant, son adoption par les professionnels de la santé est freinée par plusieurs enjeux, tels que la crainte d'une perturbation de la relation thérapeutique, les préoccupations liées à la protection des données et la charge administrative supplémentaire qu'elle peut engendrer, notamment avec les dossiers médicaux électroniques. Cette charge est souvent citée comme un facteur de risque de burnout.

But de la thèse

Cette thèse avait pour objectif d'évaluer l'utilisation des outils de santé digitale par les médecins de premier recours en Suisse et dans 10 autres pays de l'OCDE.

Le premier chapitre, « *Primary care physician eHealth profile and care coordination : a cross-sectional study* », visait à examiner la relation entre l'utilisation de ces outils et la coordination des soins en Suisse.

Le deuxième chapitre, « *Primary care physician eHealth profile and burnout : an international cross-sectional study* », explorait pour sa part le lien entre l'usage de la santé digitale et le burnout, ainsi que d'autres paramètres connexes dans les 10 pays de l'OCDE.

Méthodes

Le Commonwealth Fund (CWF) est une organisation à but non lucratif basée aux États-Unis. Elle mène tous les ans, en alternance, des enquêtes nommées « International Health Policy (IHP) Survey » dans plusieurs pays de l'OCDE, auprès des médecins de premier recours, de la population âgée de plus de 18 ans et de la population âgée de 65 ans ou plus. Ces enquêtes visent à comparer les performances des systèmes de santé des différents pays. Dans le cadre des deux chapitres de cette thèse, nous avons réalisé une analyse secondaire de l'IHP de 2022, qui concernait les médecins de premier recours de dix pays de l'OCDE (Suisse, Australie, Canada, France, Allemagne, Pays-Bas, Nouvelle-Zélande, Suède, Royaume-Uni et États-Unis d'Amérique). Les données de cette édition ont été collectées entre février et septembre 2022.

Nous avons utilisé les données concernant les caractéristiques des médecins de premier recours et de leur lieu de travail. Afin d'évaluer l'utilisation de la santé digitale par les médecins, nous avons construit un score de santé digitale à partir des réponses à 10 questions concernant la téléconsultation, l'usage d'outils de santé connectés, l'utilisation de dossiers médicaux électroniques et l'offre de différents services connectés pour les patients. En assignant une valeur de 0 ou 1 à ces éléments, nous avons obtenu un score allant de 0 à 10. Nous avons présenté des statistiques descriptives de l'usage de cette santé digitale en Suisse (chapitre 1), puis dans les 10 pays de l'OCDE, en comparant cette utilisation entre les pays (chapitre 2).

Dans le premier chapitre de cette thèse s'intéressant à la coordination des soins, nous avons présenté des statistiques descriptives, puis nous avons établi un score de coordination à partir de 5 questions concernant la présence d'infirmières ou de gestionnaires de cas pour aider à gérer les maladies chroniques, la communication avec les spécialistes et la collaboration avec les prestataires de soins à

domicile et les services sociaux. Comme pour le score de santé digitale, nous avons assigné une valeur de 0 ou 1 é ces éléments et avons obtenu un score de 0 à 5. Afin d'évaluer la relation entre l'utilisation de la santé digitale et la coordination des soins, nous avons effectué des analyses de régression linéaires entre les deux scores, une fois sans ajustement et une fois avec ajustement pour le genre, l'âge, la spécialisation médicale et le cadre d'exercice du médecin de premier recours.

Dans le deuxième chapitre de cette thèse, nous avons présenté des statistiques descriptives du burnout des médecins de premier recours et d'autres paramètres connexes, tels que le stress perçu, la satisfaction quant à la charge de travail quotidienne, au temps consacré aux tâches administratives et à l'équilibre entre vie professionnelle et vie privée. Nous avons ensuite présenté une comparaison de la prévalence du burnout entre les différents pays et avons utilisé des régressions logistiques pour étudier la relation entre le score de santé digitale, le burnout et d'autres paramètres connexes.

Résultats

Le premier chapitre, consacré à l'analyse de l'utilisation de la santé digitale et de son association avec la coordination des soins par les médecins de premier recours en Suisse, a révélé que les outils digitaux de santé étaient relativement peu utilisés dans ce pays. Par exemple, 17 % des médecins n'utilisaient pas de dossiers médicaux électroniques et 63 % n'utilisaient jamais d'outils connectés pour surveiller la santé de leurs patients atteints de maladies chroniques. Nos résultats suggèrent une association modeste entre le score de santé digitale et le score de coordination des soins.

Le deuxième chapitre décrit l'usage de la santé digitale par les médecins de premier recours de 10 pays de l'OCDE, l'évaluation de leur niveau de burnout et d'autres paramètres y étant associés, ainsi que la relation entre l'usage de la santé digitale et le burnout (et autres paramètres connexes). Nos résultats ont révélé d'importantes variations d'un pays à l'autre, tant en ce qui concerne l'adoption de la santé digitale que la prévalence du burnout. Les Pays-Bas, le Royaume-Uni et la Nouvelle-Zélande ont obtenu les scores les plus élevés en matière de santé digitale, tandis que l'Allemagne et la Suisse ont enregistré les scores les plus bas. Selon ces données, le burnout touchait 35 % des médecins dans l'ensemble, avec des taux particulièrement élevés en Nouvelle-Zélande (49 %) et au Canada (46 %), et des taux plus faibles aux Pays-Bas (12 %) et en Suisse (18 %).

Nous n'avons trouvé aucune association entre le score de santé digitale et le burnout, la satisfaction liée au stress professionnel, la charge administrative ou l'équilibre entre vie professionnelle et vie privée. Toutefois, une relation a été trouvée entre la santé digitale et l'insatisfaction liée à la charge de travail quotidienne.

Conclusion et implications

Cette thèse a exploré l'utilisation des outils de santé digitale par les médecins de premier recours en Suisse et dans 10 pays de l'OCDE, ainsi que ses liens avec la coordination des soins et le burnout. En Suisse, les résultats indiquent une adoption encore limitée de la santé digitale, avec une utilisation encore restreinte des dossiers médicaux électroniques et des outils connectés pour la gestion des maladies chroniques. Il a été observé une association modeste entre un score élevé en matière de santé digitale et une meilleure coordination des soins.

À l'échelle internationale, de grandes différences sont apparues entre les pays concernant l'adoption de la santé digitale et la prévalence du burnout. Les scores de santé digitale les plus élevés ont été observés aux Pays-Bas, au Royaume-Uni et en Nouvelle-Zélande, tandis que l'Allemagne et la Suisse affichaient les niveaux les plus faibles. Aucun lien n'a été mis en évidence entre l'utilisation de la santé digitale et le burnout, le stress perçu ou l'équilibre entre la vie professionnelle et la vie privée. Toutefois, une association a été observée entre un score élevé en matière de santé digitale et une insatisfaction accrue concernant la charge de travail quotidienne.

Ces résultats laissent entrevoir une possible synergie entre la transformation digitale et la coordination des soins. Selon ces données, la santé digitale ne semblait pas être associée au burnout chez les médecins de premier recours. Toutefois, leur association avec l'insatisfaction concernant la charge de travail quotidienne suggère que, si les outils digitaux sont destinés à soutenir la pratique clinique, ils peuvent également accroître la charge de travail et la complexité administrative.

Si la santé digitale pourrait être bénéfique pour les patients, nos résultats soulignent la nécessité d'optimiser sa mise en œuvre afin qu'elle allège la charge de travail des médecins au lieu de l'exacerber.

Chapiter 1: Primary care physician eHealth profile and care coordination : a cross-sectional study

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Primary care physician eHealth profile and care coordination: a cross-sectional study

Mathieu Jendly[a], Valérie Santschi[b], Stefano Tancredi[a], Arnaud Chiolero[acd]

[a] Population health laboratory (#PopHealthLab), University of Fribourg, Fribourg, Switzerland
[b] La Source, School of Nursing Sciences, HES-SO University of Applied Sciences and Arts Western Switzerland, Lausanne, Switzerland
[c] School of Population and Global Health, McGill University, Montreal, QC, Canada
[d] Institute of Primary Health Care (BIHAM), University of Bern, Bern, Switzerland

Summary

BACKGROUND: Digital health holds promise for enhancing care coordination and supporting patient self-management. However, various barriers, including at the healthcare professional level, hinder its adoption. This cross-sectional study explored the eHealth profile of primary care physicians and its relationship with care coordination.

METHODS: As part of "The Commonwealth Fund's 2022 International Health Policy Survey of Primary Care Physicians in 10 Countries", 1114 physicians in Switzerland completed a questionnaire on their sociodemographic and workplace characteristics, digital health use and care coordination practices. Based on their responses concerning the modality, frequency and application of digital health tools, we created a digital health score. Based on responses describing the collaboration with specialists and paramedical health professionals, we created a care coordination score. The associations between both scores were assessed using stratified analyses and multiple linear regression.

RESULTS: Among the 1114 participants (46% women, mean age 52 years), 83% used electronic patient records, 96% used teleconsultations for less than 5% of consultations, and 63% never used connected health tools to monitor patients with chronic diseases. Further, 16% allowed online appointments, 20% online medical prescriptions, 52% the possibility of electronically communicating lists of medications with other healthcare professionals, and 89% the possibility of email or web communications with the patient. The eHealth score was positively associated with the number of weekly working hours, being an internal medicine specialist or practising physician, the number of full-time equivalents in the practice and being in a group practice setting. The higher the eHealth profile score, the higher the care coordination score.

CONCLUSION: Digital health and care coordination were positively associated. This could underscore the potential benefits of digital health in enhancing collaborative and interprofessional care practices.

Prof. Arnaud Chiolero, MD, PhD
Population health laboratory
University of Fribourg
Route des Arsenaux 41
CH-1700 Fribourg
arnaud.chiolero[at]unifr.ch

Introduction

Digital health, or eHealth – a vast field encompassing mobile health (mHealth), health information technology, wearable devices, telehealth and telemedicine – is changing the practice of medicine [1]. Growing evidence suggests that digital health could help manage chronic conditions such as diabetes [2] and cardiovascular diseases [3] and enhance patient well-being [4]. It could also ease the delivery of health services through digital communication technologies [5] and improve medication adherence [6], which is crucial in addressing the challenges posed by increasing polypharmacy related to the rising burden of chronic diseases in the ageing population [7].

Care coordination is a critical component of a strong primary care system [8], and the digitalisation of medicine could help care coordination between healthcare professionals [5]. Patients increasingly can digitally monitor their health and share health data with healthcare professionals, strengthening their empowerment [9]. Access to digital tools, notably through primary healthcare providers, could be one element strengthening care coordination, notably to foster team-based and patient-centred care for the management of chronic diseases [10]. However, the acceptance of digital health by healthcare providers, including primary care physicians, is notably hindered by concerns that it may disrupt the therapeutic relationship with the patient and by the lack of evidence on its benefits and risks [11].

A survey carried out among Finnish physicians showed that 46% felt that digital health could promote an active role for patients in their care and 44% thought that it could improve their access to information [12]. In Germany, another survey showed that around 68% of doctors were positive about mHealth applications, but only 14% had ever prescribed them [13]. The American Medical Association reported that all forms of digital health tools have increased over recent years, from teleconsultations to clinical

ABBREVIATIONS

CWF:	Commonwealth Fund
FMH:	Foederatio Medicorum Helveticorum
eHealth:	digital health
IHP:	International Health Policy
mHealth:	mobile health

decision tools and workflow improvements. Furthermore, the doctors surveyed felt that digital health was improving clinical outcomes, diagnostic capabilities and care coordination [14]. In Switzerland, an "eHealth barometer" survey is regularly carried out among doctors and other healthcare professionals. In 2024, it revealed that the perceived potential for eHealth and the use of electronic systems to store and manage patient data were increasing. However, this survey does not examine the relationship between digital health and care coordination [15].

A better understanding of the use of digital health in patient care by primary care physicians and its relationship with care coordination is thus important. Using data from a large survey of primary care physicians, we aimed to (1) describe the digital health use of primary care physicians in Switzerland and its associations with sociodemographic characteristics and (2) assess the relationship between a digital health score (a score built on various items studying the physicians' use of and involvement in digital health) and the degree of care coordination.

Materials and methods

Study design

We conducted a secondary analysis of the 2022 International Health Policy (IHP) Survey of the Commonwealth Fund (CWF). The CWF is a non-profit foundation in the USA that has been conducting IHP surveys since 1998 to compare the health system performances of the USA and other high-income countries. The methodology of the IHP has been described elsewhere [16]. Since 2010, Switzerland has been one of the 11 participating high-income countries (with Australia, Canada, France, Germany, the Netherlands, New Zealand, Norway, Sweden, the United Kingdom and the USA). Three target groups are surveyed every 3 years: the resident population aged 18 years and over, the resident population aged 65 years and over, and primary care physicians [17]. In 2022, the IHP survey of primary care physicians, on which our analysis was based, was conducted in 10 countries (Norway did not participate).

Participants

We used the data from the Swiss participants of the 2022 IHP survey. In Switzerland, the most common training to become a primary care physician is a specialisation in internal medicine or paediatrics, both lasting 5 years. Another possibility is to become a "practising physician": a physician following shorter training, generally 3 years, after which they can set up practice in an outpatient setting [18]. In Switzerland, a large and growing share of physicians is trained abroad. The Swiss Medical Association (FMH [Foederatio Medicorum Helveticorum]) provided the CWF with a random sample of 4000 physicians, chosen from a pool of 8354 physicians registered in 2022, providing outpatient care and with a specialist title of internal medicine (n = 5891), practising physician (n = 1175) or paediatrician (n = 1288). Some 1114 participants completed the questionnaire and constituted our study population (participation rate: 28%). This sample did not include specialists working in a hospital. The flowchart of the participants included in the study is shown in figure 1.

Data collection and measurement

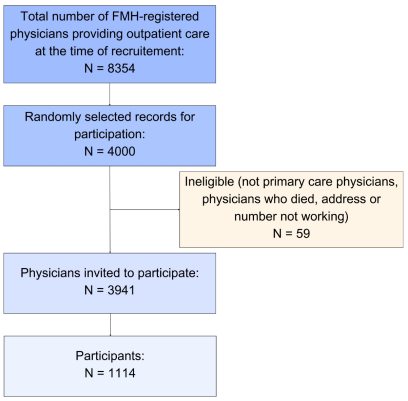
Between March and May 2022, the physicians completed an online questionnaire about their personal and workplace characteristics, their use of digital health and their care coordination. The questionnaire was designed by the CWF, and the data collection in Switzerland was carried out by the company demoSCOPE. The questionnaire aimed to provide information on the physicians' individual and workplace characteristics, care coordination, digital transformation, and evaluation of their work and the healthcare system in general [19].

For our analysis, we used the following physician and workplace characteristics: age, sex, degree of urbanisation of the practice location, speciality, weekly working hours, number of patients seen per week, type of practice setting (a group practice setting means a practice with at least two physicians) and number of full-time equivalents in the practice.

The assessment of physicians' digital health use was based on their responses to 10 questions about teleconsultation, the use of connected health tools, electronic patient records and various online services for patients. We built the digital health score based on those items by assigning a value of 0 or 1 to each response and adding these values to obtain a score ranging from 0 to 10. The higher the digital health score, the higher the physicians' use of and involvement in digital health.

A care coordination score was built based on the responses to five questions about the presence of nurses or case managers to help manage chronic conditions, communication with specialists, and collaboration with home care providers and social services. We built the care coordination score in the same way as the digital health score. Since only five questions on care coordination were available, the score ranged from 0 to 5. We assumed that the higher the care coordination score, the higher the physicians' coordination with other healthcare professionals. The scores were created based on background knowledge and authors' expertise because no score exists for physicians' digital health use or care coordination based on the IHP data.

Figure 1: Flowchart of participants (n = 1114).



Statistical analysis

For the first aim of this study, we reported descriptive statistics on the characteristics, digital health use and care coordination of the primary care physicians. We presented the continuous variables as mean and standard deviation (SD) and categorical variables as number and percentage (%).

For the second aim, we assessed the association between the digital health score and the care coordination score. We first stratified the data by physician characteristics. We then modelled the association between the two scores through two linear regression analyses: one was unadjusted, and the other was adjusted for age, sex, medical speciality and type of practice setting.

Very few data were missing. For both scores, when the answer to a question was missing, we assigned a value of 0.

Ethical approval

Ethical approval was obtained to conduct the IHP of the CWF, and no additional approvals were required for secondary analysis of IHP survey data.

Results

The characteristics of the 1114 physicians are shown in table 1. The mean age was 52 years, and 46% were women. Most physicians were German-speaking (70%), had an internal medicine speciality (73%), worked in an urban setting (70%) and worked in a group practice (65%).

Descriptive statistics of the care coordination of physicians are shown in table 3. Most physicians (79%) shared patient history with specialists during referral 75% of the time or more and shared (59%) or received (71%) patient information from homed-based nursing care 50% of the time or more. Some 56% were collaborating with nurses or case managers inside or outside the practice to help chronic disease management, and 94% had some collaboration with social services. The mean digital health score was 4.1 (SD: 2.0), and the median score was 4 (interquartile range [IQR]: 2 to 6). The care coordination score ranged from 0 to 5, with a mean of 3.6 (SD: 1.3) and a median of 4 (IQR: 3 to 5). Both scores increased as the number of weekly working hours increased (see stratified analyses in appendix table S1). Physicians' speciality was associated with both scores, with paediatricians having the lowest means in both scores and practising physicians having the highest digital health scores. The digital health score was also associated with more full-time equivalent staff in the practice and being in a group practice setting compared to solo practice.

Figure 2 shows the mean care coordination score stratified by physicians' digital health score. The higher the care coordination score, the higher the digital health score. Table 4 shows the regression between the digital health score and the care coordination score, unadjusted and adjusted for age, sex, medical speciality and group practice setting. We found a positive association between both scores (regression coefficient 0.06, 95% confidence interval [CI] 0.03–0.10, p = 0.001).

Table 1:
Characteristics of primary care physicians and practice care settings (n = 1114).

Characteristic		n (%)
Age [years], mean, SD		52, 10.6
Sex	Female	516 (46)
	Male	598 (54)
Language	German	780 (70)
	French	242 (22)
	Italian	85 (8)
	Rhaeto-Romansch	7 (1)
Community type	Urban	781 (70)
	Intermediate	201 (18)
	Rural	132 (12)
Medical specialty	Internal medicine	812 (73)
	Practising physician	127 (11)
	Paediatrician	175 (16)
Weekly working hours	Less than 35	286 (26)
	35–44	258 (23)
	45 or more	568 (51)
Number of patients seen per week	Less than 70	441 (40)
	70–119	418 (38)
	120 or more	251 (23)
Type of practice setting	Solo practice	338 (30)
	Group practice*	729 (65)
	Other	47 (4)
Number of full-time equivalents in office	Less than 2	550 (49)
	2 to 3	384 (34)
	4 or more	176 (16)

SD: standard deviation

* At least two physicians.

Discussion

This study aimed to explore the digital health use and care coordination practices of primary care physicians in Switzerland. Our results indicate a greater use of digital health tools in physicians who had more weekly working hours, worked in group practice settings and were practising physicians. This suggests that physicians who dedicated more time to their professional activities tended to have higher utilisation of digital health. Our results also indicate that physicians in solo practices were less likely to engage in digital health compared to their colleagues in

Table 2:
Digital health score items of primary care physicians (n = 1114).

Digital health use		Score	n (%)
Proportion of consultations by video	5% or more	1	36 (3)
	Less than 5%	0	1071 (96)
Use of connected health tools to monitor the health of patients with chronic diseases	25% or more	1	185 (17)
	Less than 25%	0	229 (21)
	Never (0%)	0	699 (63)
Use of electronic patient medical records	Yes	1	928 (83)
	No	0	186 (17)
Possibility to electronically communicate patient clinical summaries	Yes	1	586 (53)
	No	0	528 (47)
Possibility to electronically communicate diagnostic and laboratory tests	Yes	1	665 (60)
	No	0	447 (40)
Possibility to electronically communicate lists of medications	Yes	1	574 (52)
	No	0	539 (48)
Practice allowing email or web communications with patients	Yes	1	986 (89)
	No	0	128 (11)
Practice allowing online appointment-taking with patients	Yes	1	177 (16)
	No	0	936 (84)
Practice allowing online medical prescription renewal	Yes	1	226 (20)
	No	0	888 (80)
Practice allowing online laboratory result acknowledgement by patients	Yes	1	204 (18)
	No	0	907 (81)
Use or plan to use the Swiss-wide “electronic patient record”	Already use it	0	28 (3)
	Plan to use it within the next 2 years	0	268 (24)
	Plan to use it within 2 years or more	0	379 (34)
	Not using it and not planning to	0	433 (39)

* Values used to build the score. We summed all variables to obtain a score ranging from 0 to 10.

Table 3:
Care coordination score items of primary care physicians (n = 1114).

Care coordination		Score*	n (%)
Presence of a nurse or case manager to help chronic disease management inside or outside the practice	Yes	1	624 (56)
	No	0	490 (44)
When your patients have been referred to a specialist, how often do you send the patient history and the reason for the consultation to the specialist?	75% or more	1	876 (79)
	25–74%	0	162 (15)
	Less than 25%	0	75 (7)
For your patients who receive home-based nursing care, how often do you communicate with home-based nursing care providers about your patients’ needs and the services to be provided?	50% or more	1	656 (59)
	25–49%	0	229 (11)
	Less than 25%	0	114 (10)
	Does not apply	0	115 (10)
For your patients who receive home-based nursing care, how often are you advised by the home-based nursing care providers of a relevant change in your patients’ condition or health status?	50% or more	1	788 (71)
	25–49%	0	123 (11)
	Less than 25%	0	86 (8)
	Does not apply	0	111 (10)
Collaboration with social services	Some collaboration	1	1043 (94)
	No collaboration	0	71 (6)

* Values used to build the score. We summed all variables to obtain a score ranging from 0 to 5.

Table 4:
Regression between digital health score and care coordination score (n = 1114), unadjusted and adjusted for age, sex, medical speciality and type of practice setting.

Variable	Beta coefficient (95% CI)	R-squared	Prob >F	p-value
Unadjusted digital health score	0.06* (0.02–0.10)	0.01	0.001	0.001
Adjusted digital health score	0.06* (0.02–0.09)	0.17	<0.001	0.001

CI: confidence interval.

* For a difference of one unit in the digital health score, a difference existed in the care coordination score of an average of 0.06 units.

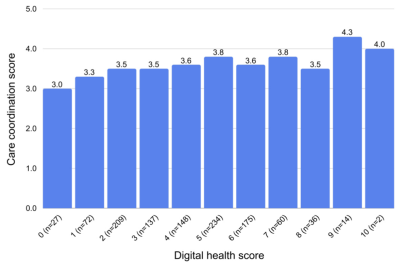
group practice settings. This disparity could be attributed to the initial costs of electronic health records, along with the technical and time-related challenges associated with the adoption of digital health, which are frequently cited as barriers to its implementation and could be more easily addressed in collaborative environments [20].

We found a modest correlation between primary care physicians' digital health score and care coordination score, suggesting that physicians who embraced digital health were overall more likely to engage in collaborative practices, such as sharing patient information with specialists and collaborating with home-based nursing care. Given other studies on the association of digital health with care coordination [21], considering that one could influence the other is becoming mainstream. However, due to the design of our study and the modest degree of association, this positive relationship could be confounded.

Many barriers exist to the adoption of digital health at both the patient and clinician levels. Our study shows a slight positive association between working hours and digital health use, where individuals with higher digital health use were also working more. A possible explanation is that physicians who work more tend to use more digital health tools to try to reduce their workload. However, the use of digital health could also add workload, which is often cited as a barrier to digital health adoption [22]. As suggested by a study published in 2021 in the Netherlands, this barrier can be addressed by adapting new technologies to the organisational structure and daily care processes and deploying the human resources required for daily care processes in line with the desired results [23]. This would reduce workload and increase adherence to digital health.

Internationally, the uptake of digital health varies by country, and Switzerland is often considered to lag behind many other countries. The International Health Policy Survey also revealed that, among the 10 OECD (Organisation for Economic Co-operation and Development) countries, Swiss physicians used the least electronic medical records and rarely transmitted patient-related documents electronically [19]. If the benefits of digital health are confirmed for patients and potentially for healthcare professionals, considering the central role of primary care physicians in patient care and engagement, policies seem necessary to enhance its implementation through better uptake among primary care physicians.

Figure 2: Mean care coordination score by eHealth score (n = 1114).



This study has some limitations. The survey was completed online and probably selected participants who were more likely to be involved in digital tools. The relatively low participation rate could have led to participation bias, and participants were probably keener to use eHealth tools. Nevertheless, the characteristics of primary care physicians are comparable between this survey and the 2022 FMH data. With a mean age of 52 versus 54 years for primary care physicians, and 46% versus 44% women, respectively [24], this similarity suggests that the survey may provide a representative portrayal of the situation in Switzerland. Additionally, self-reported information was reported in the questionnaire, suggesting a possible information bias.

A key limitation of the study is that we cannot claim that digital health use is the cause of greater care coordination. A causal relationship is possible, but it is also possible that both reflect another factor specific to the physician. Furthermore, although variables concerning medical and paramedical professionals were included, many aspects of care coordination were not fully reflected in the current score. Our study is a secondary data analysis and is strongly constrained by the data collected in this survey. Regarding the scores, we did not have another dataset to validate the score and did not perform any internal validation. We did not find a validated score that would fit our data.

The main strength of this study is its large number of participants from a random sampling of a significant share of physicians in the country. It also covers many variables characterising care coordination and the use of digital health and describes a wide range of possible uses for eHealth.

In conclusion, our findings might help better understand the use of digital health in primary care physicians in Switzerland and its association with care coordination. Recognising the factors associated with the adoption of digital health tools is essential for developing targeted strategies to overcome barriers and promote a more universally integrated and effective healthcare system.

Open science

The data and the code used to perform the analyses of this study can be shared upon request. Data are publicly available by contacting the CWF. A protocol or registration for this study was not prepared. Statistical analyses were performed using Stata 17 software (Stata Corp, TX, 2021) without using specific packages.

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Authors' contributions: *MJ*, *VS*, *ST* and *AC* wrote the protocol for the study. *MJ* analysed the data under the guidance of *ST* and drafted the manuscript with contributions by *VS*, *ST* and *AC*. All authors revised and approved the final version of the manuscript before submission.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

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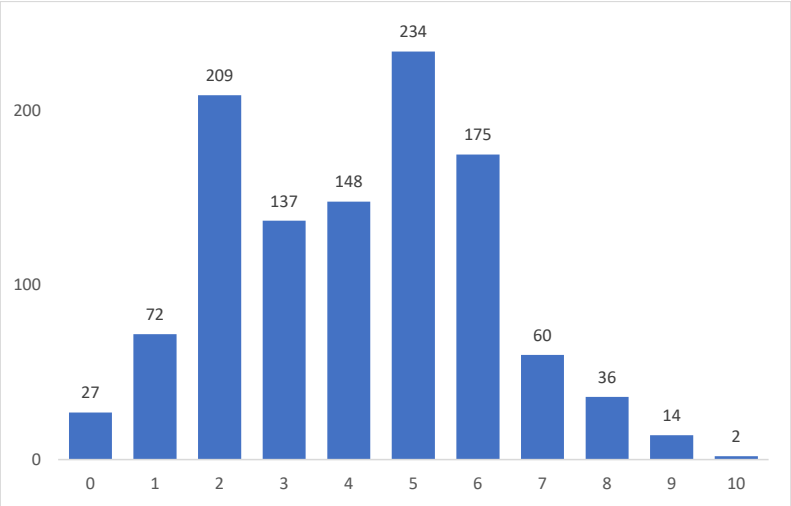
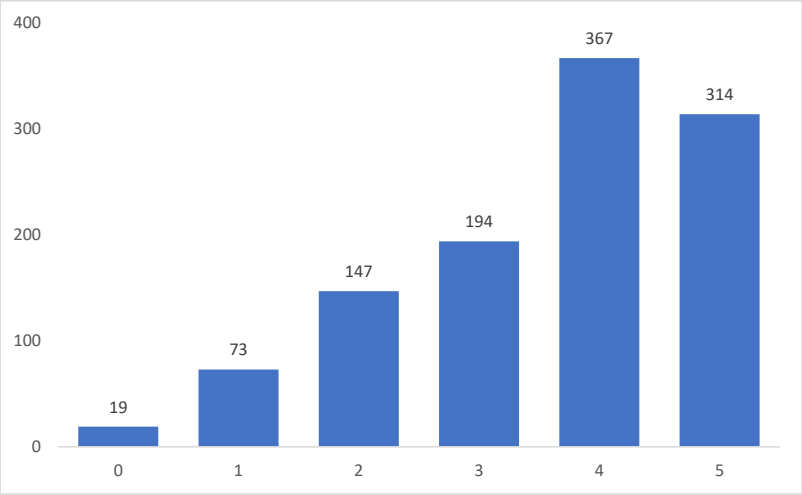
Appendix

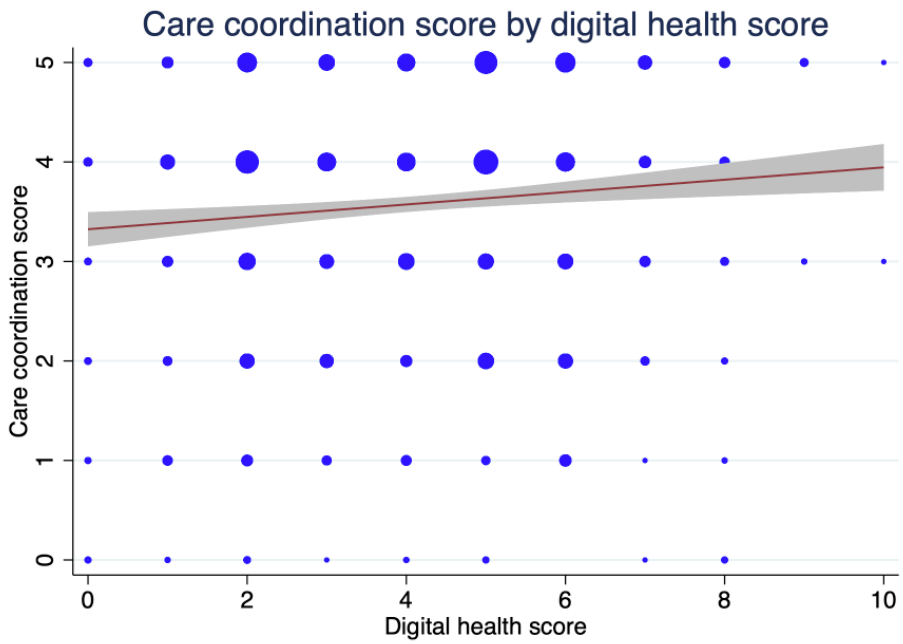
Supplementary Figure S1: Distribution of the digital health score (N = 1114).



Supplementary Figure S2: Distribution of the care coordination score (N = 1114).



Supplementary Figure S3: Scatterplot of the care coordination score by digital health score* (N = 1114).



* The size of the dots is proportional to the frequency of the outcome.

Chapter 2 : Primary care physician digital health profile and burnout : an international cross-sectional study

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Primary care physician digital health profile and burnout: an international cross-sectional study

Mathieu Jendly[1,*], Valérie Santschi[2], Stefano Tancredi[1,3], Viktor von Wyl[3,4,5], Arnaud Chiolero[1,3,6,7]

[1]Population Health Laboratory (#PopHealthLab), University of Fribourg, Fribourg, Switzerland
[2]La Source, School of Nursing Sciences, HES-SO University of Applied Sciences and Arts Western Switzerland, Lausanne, Switzerland
[3]Swiss School of Public Health (SSPH+), Zurich, Switzerland
[4]Epidemiology, Biostatistics and Prevention Institute – EBPI, University of Zurich, Zurich, Switzerland
[5]Institute for Implementation Science in Health Care – IfIS, University of Zurich, Zurich, Switzerland
[6]School of Population and Global Health, McGill University, Montreal, QC, Canada
[7]Institute of Primary Health Care (BIHAM), University of Bern, Bern, Switzerland

*Corresponding author. Population Health Laboratory (#PopHealthLab), University of Fribourg, Route des Arsenaux 41, 1700 Fribourg, Switzerland. E-mail: mathieu.jendly@unifr.ch.

Abstract

Background: Digital health offers promising solutions for enhancing patient care, yet adoption varies among physicians, partly due to concerns about administrative burdens and burnout. This study assessed digital health use and burnout among primary care physicians in 10 OECD countries and examined their relationship. **Methods:** We conducted a secondary analysis of "The Commonwealth Fund's 2022 International Health Policy Survey," including 9526 randomly selected primary care physicians (general practitioners or pediatricians in ambulatory care) from 10 OECD countries. We created a digital health score based on the use and frequency of digital tools. Self-reported burnout and related outcomes were analyzed. Cross-country differences were assessed using stratified analyses. Associations between digital health and burnout and related outcomes were explored using stratified analyses and logistic regressions. **Results:** Most physicians used electronic records; video consultations or connected tools for chronic care. Digital health scores were highest in the Netherlands and UK, and lowest in Germany and Switzerland. 35% of physicians reported burnout, with the highest prevalence in New Zealand (49%) and Canada (46%), and lowest in the Netherlands (12%) and Switzerland (18%). Digital health use positively correlated with workload dissatisfaction but not with burnout, stress, satisfaction with administrative work, or work-life balance. **Conclusion:** Physicians' digital health use and burnout varied substantially across countries but were not correlated. While digital health is often considered a factor linked to physician burnout, our results do not support this view. They also highlight the need to ensure that digital health reduces, rather than exacerbates, physicians' workload.

Introduction

Digital health encompasses technologies such as mobile health (mHealth), health information technology, wearable devices, telehealth, and telemedicine [1]. It holds promise for improving chronic conditions management [2, 3] and enhancing patient well-being [4]. For instance, digital health enables patient-centred health services through communication technologies [5, 6], which are increasingly important amid the growing burden of chronic diseases in aging populations [7]. Despite its promises, the adoption of digital health faces significant challenges at both individual and systemic levels. For example, physicians often worry about disruptions to patient relationships [8] and insufficient evidence on the benefits and risks of digital tools [9]. The adoption of digital tools is further complicated by disparities in their access across countries [10]. Primary care physicians are central to this adoption, as they are often the first point of contact in the healthcare system. Hence, they could play a key role in guiding patients in the use of such technologies [11].

The Unified Theory of Acceptance and Use of Technology (UTAUT) framework helps explain barriers to the implementation of digital health tools. Within this framework, four main factors—performance expectancy, effort expectancy, social influence, and facilitating conditions—determine whether individuals adopt or resist new technologies [12, 13]. Concerns about the effectiveness of digital tools may lower performance expectancy. Increased administrative burden caused by digital health tools [14] may lower effort expectancy, as physicians may perceive these tools as too demanding. While one of their goals is to reduce the workload, they can also paradoxically contribute to burnout, an effect that could be mitigated through improved technology and workflow optimization [15]. These dynamics help understand healthcare professionals' resistance to adoption.

Burnout is also a factor that may be intertwined with the adoption of digital health. Defined as "a syndrome […] resulting from chronic workplace stress that has not been successfully managed" [16], it is frequent among physicians [17]. The Commonwealth Fund's 2022 International Health Policy Survey found that nearly half of primary care physicians in several OECD (Organisation for Economic Co-operation and Development) countries reported being burned out, which could accelerate the primary care shortage [18]. Burnout correlates with reduced care quality and empathy, and increased clinical errors [19]. On the one hand, the growing administrative burden associated with electronic health records is a recognized contributor to burnout [20]. On the other hand, digital health could also act as a facilitator, due to its ability to alleviate some of these burdens [21], potentially giving physicians more time for clinical activities and patient interaction. Understanding the link between primary care physician burnout and digital health adoption is important, as primary care physicians play a pivotal role in the wider uptake of digital health technologies by patients.

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Therefore, using data from a large survey of primary care physicians across 10 OECD countries, we aimed to assess cross-country differences in primary care physician digital health use and burnout, as well as the relationship between digital health use and burnout.

Methods

Study design

We conducted a secondary analysis of the 2022 International Health Policy (IHP) Survey of the Commonwealth Fund (CWF), whose methodology has been described elsewhere [22]. The CWF is a non-profit foundation in the USA that has been conducting IHP surveys since 1998 to compare the health system performances in USA and several other high-income countries. Three target groups are surveyed every three years, that is, the resident population aged 18 years and over, the resident population aged 65 years and over, and primary care physicians [23].

Our analysis focused on the 2022 IHP physician survey conducted in 10 OECD countries (Australia, Canada, France, Germany, the Netherlands, New Zealand, Sweden, Switzerland, the United Kingdom, and the United States of America). Ethical approval was obtained for the original survey, no additional approval was required for secondary analysis.

Target and study populations

We included all respondents to the 2022 IHP survey. The target populations are primary care physicians not working in hospitals. In several countries (e.g. Australia, New Zealand, the Netherlands, and the UK) included in this survey, primary care physicians treat children and adults. In countries where primary care physicians exclusively treat adults (the United States of America and Switzerland), pediatricians working in ambulatory care were also invited to participate and represented 14% and 16% of physicians, respectively. Germany excluded pediatricians from the sample. The CWF partnered with various statistics companies to identify the target population (i.e. all potentially eligible physicians) and obtained a random sample from this group to send the questionnaire. However, the number of physicians in the target population (i.e. number of potentially eligible physicians per country) was not specified for some countries. The eligibility of participants was assessed by the local agencies that provided lists of participants. Ineligible participants were mainly composed of primary care physicians who screened out as not being involved in primary care, being retired, having changed addresses or phone numbers, and being deceased. In Germany, survey invitations were managed by the regional medical associations, with varying approaches: five out of seventeen associations contacted all members by email, nine included a survey note in their newsletter, and three did not disclose their recruitment strategy. Consequently, a response rate could not be calculated for Germany, and the detailed participation process could not be precisely described [22].

The targeted study populations, the random sample of physicians eligible to participate, the sample of physicians invited to participate, and the number of participants per country are shown in Supplementary Table S1. In total, 9526 completed the questionnaire and constituted our study sample (Supplementary Fig. S6), with participation ranging from 4.3% to 39.1% across countries.

Data collection and measurement

Between February and September 2022, physicians completed an online, mail, postal, or phone questionnaire covering personal and workplace characteristics, their work-related satisfaction, their burnout symptoms, and digital health use. For our analysis, we used the following physician and workplace characteristics to provide insights into the type of medical practice across countries: country, age, gender, degree of urbanization of the practice location, weekly working hours, number of patients seen per week, and number of full-time equivalents in the practice. These characteristics are displayed in Table 1.

Table 1. Characteristics of primary care physicians and practice care settings ($N = 9526$)

Characteristics	*N* (%)
Country	
Australia	321 (3)
Canada	1459 (15)
France	530 (6)
Germany	947 (10)
Netherlands	617 (6)
New Zealand	377 (4)
Sweden	2092 (22)
Switzerland	1114 (12)
United Kingdom	1010 (11)
United States	1059 (11)
Age [year]	
Under 35	1041 (11)
35–44	2755 (29)
45–54	2330 (24)
55–64	2287 (24)
65 or older	1097 (12)
Gender	
Women	4573 (48)
Men	4910 (52)
Other	11 (<1)
Community type	
Urban	4065 (43)
Intermediate	3525 (37)
Rural	1901 (20)
Weekly working hours	
Less than 35	2188 (23)
35–44	2654 (28)
45 or more	4500 (47)
Number of patients seen per week	
Less than 70	3771 (40)
70–119	2721 (29)
120 or more	2712 (28)
Number of patients seen per hour	
Less than 2	4519 (47)
2–4	3521 (37)
4 or more	954 (10)
Number of full-time equivalents in the office	
Less than 2	2191 (23)
2–3	1392 (15)
3–6	2923 (31)
6 or more	2681 (28)

Physicians' digital health use was assessed by computing a score based on responses to 10 questions about teleconsultation, use of connected health tools, electronic patient records, and various online services for patients. Table 2 shows the items on which the digital health score is based, by assigning a value of 0 or 1 to each response, and by adding up these values to get a score ranging from 0 to 10. The higher the digital health score, the higher the physicians' use and involvement in digital health. The score was created based on background knowledge and authors' expertise [24] because it is simple yet comprehensive, covering many aspects of digital health, such as telemedicine, connected health tools, electronic health records, and various aspects of digital services among doctors and between patients and practices. Furthermore, no previous score that assessed physicians' digital health use based on these survey data could be found. This score was used in our previous research using the same dataset to assess the digital health profile of primary care physicians in Switzerland [24].

Burnout was assessed using a single categorical self-reported item, as shown in Table 2. Physicians were considered in burnout if their answer to the question was: "I am burning out and have one or more

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Table 2. Digital health score items and burnout and related outcomes of primary care physicians ($N = 9526$)

	Variable	Outcome [score[a]]	*N* (%)
Digital health use	Percentage of consultations by video	5% or more [1]	2325 (24)
		Less than 5% [0]	7079 (74)
	Use of connected health tools to monitor the health of patients with chronic diseases	25% or more [1]	3529 (37)
		Less than 25% [0]	5796 (61)
	Use of electronic patient medical records	Yes [1]	8812 (93)
		No [0]	680 (7)
	Possibility to communicate electronically patient clinical summaries	Yes [1]	5947 (62)
		No [0]	3286 (35)
	Possibility to communicate electronically diagnostic and laboratory tests	Yes [1]	6560 (69)
		No [0]	2690 (28)
	Possibility to communicate electronically list of medications	Yes [1]	6109 (64)
		No [0]	3089 (32)
	Practice allowing e-mail or web communications with patients	Yes [1]	7216 (76)
		No [0]	2181 (23)
	Practice allowing online appointment taking with patients	Yes [1]	4854 (51)
		No [0]	4367 (46)
	Practice allowing online medical prescriptions renewal	Yes [1]	5691 (60)
		No [0]	3728 (39)
	Practice allowing online lab results acknowledgement by patients	Yes [1]	5424 (57)
		No [0]	3885 (41)
Burnout self-assessment and burnout-related outcomes	Overall, based on your definition of burnout, how would you rate your current level of burnout?	I enjoy my work. I have no symptoms of burnout.	1286 (14)
		Occasionally I am under stress, and I don't always have as much energy as I once did, but I don't feel burned out.	4807 (50)
		I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion.	2193 (23)
		The symptoms of burnout that I'm experiencing won't go away. I think about frustration at work a lot.	736 (8)
		I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help.	439 (5)
	How stressful is your job?	Extremely stressful	1927 (20)
		Very stressful	3666 (38)
		Somewhat stressful	3228 (34)
		Not too stressful	553 (6)
		Not stressful at all	81 (1)
	Satisfaction with daily workload	Extremely satisfied	123 (1)
		Very satisfied	1030 (11)
		Moderately satisfied	2943 (31)
		Slightly satisfied	2875 (30)
		Not at all satisfied	2518 (26)
	Satisfaction with time spent on administrative work	Extremely satisfied	92 (1)
		Very satisfied	319 (3)
		Moderately satisfied	1431 (15)
		Slightly satisfied	2890 (30)
		Not at all satisfied	4754 (50)
	Satisfaction with work-life balance	Extremely satisfied	302 (3)
		Very satisfied	1400 (15)
		Moderately satisfied	3339 (35)
		Slightly satisfied	2604 (27)
		Not at all satisfied	1830 (19)

a: Values used to build the digital health score. We summed all variables to obtain a score ranging from 0 to 10.

symptoms of burnout, such as physical and emotional exhaustion," "The symptoms of burnout that I'm experiencing won't go away. I think about frustration at work a lot," or "I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help." On the one hand, this single-item measure was deemed appropriate, given that physicians are familiar with burnout through both their own experiences and their clinical practice, which should render them relatively well-equipped to provide reliable self-assessments, at least when the burnout is severe. On the other hand, one major problem is that the way physicians perceive and diagnose burnout differs certainly from one country to the other, and even from one physician to the other. We also assessed several burnout-related variables such as perceived stress, satisfaction with daily workload, time spent on administrative tasks, and overall satisfaction with work-life balance.

Statistical analysis

First, we presented descriptive statistics for physician characteristics, digital health use, digital health score, and their burnout and related outcomes, i.e. perceived stress, satisfaction with daily workload, time

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spent on administrative tasks, and with work-life balance. Categorical variables are displayed as numbers and percentages, and continuous variables are displayed as mean and standard deviation.

Second, we conducted stratified analyses to assess cross-country differences in digital health scores and burnout levels. Three models were used to compute adjusted estimates of the digital health score and burnout rankings, shown in Supplementary Table S3. Model 1 shows the unadjusted means and prevalence, respectively. Model 2 was adjusted for age and gender, and model 3 was adjusted for age, gender, community type, weekly working hours, number of patients seen per week and per hour, and number of full-time equivalents in the practice. The adjustments were calculated using the standard post-estimation command "margins."

Third, we used stratified analyses and logistic regressions to examine the association between the digital health score and both burnout and related outcomes. We performed unadjusted analyses, then adjusted for age, gender, and country. Age was included because it could influence both the adoption of digital health tools and burnout, with younger physicians possibly more prone to using technology but experiencing higher stress. Gender was adjusted because it has been shown to be associated with digital health use [25] and burnout [26]. We adjusted for country to address differences in healthcare infrastructure and digital health implementation that could influence both digital health use and burnout.

For each variable, the number and percentage of missing data and alternative responses, such as "declined to answer" or "not sure" are detailed in Supplementary Table S4. Only a few data were missing or marked as alternative responses. For the digital health score items, a value of 0 was assigned if data was missing, if there was an inaccessible multiple response code, or if the participant was unsure or declined to answer.

Data availability

Data are publicly available by contacting the CWF or local health agencies of the participating countries. The code used to perform the analyses of this study can be shared upon request.

Writing and editing assistance

Language editing assistance for improving clarity and fluency of the English manuscript was provided by a large language model (ChatGPT® by OpenAI).

Results

The characteristics of the participants and their care practice setting are shown in Table 1. A total of 9526 primary care physicians from 10 OECD countries participated. Most were aged between 35 and 64 years (77%) and 48% were women. 43% practiced in urban, 37% in intermediate, and 20% in rural settings. Some 47% reported working 45 or more hours per week. Most worked together with 3 or more full-time equivalents per practice. Despite efforts to ensure comparability through random sampling, participant characteristics varied between countries (Supplementary Table S2). Physicians in Canada, France, Sweden, and the UK were generally younger. Physicians from Germany and the Netherlands were more likely to work in intermediate or rural settings. Participants from Australia and Germany reported the highest numbers of consultations per week and per hour. Solo or small-team practices (fewer than three full-time equivalents) were more common in France, Germany, the Netherlands, and Switzerland.

Table 2 shows the digital health score items, burnout and burnout-related outcomes. Electronic medical records were the most used tool (93%). Some 24% used video consultation with at least 5% of their patients, and 37% were using connected health tools (for instance connected blood glucose meters or smartwatches) to monitor chronic conditions with at least 25% of their patients. Some 23% of the participants reported symptoms of burnout, 8% answered that these symptoms would not go away, and 5% stated they were completely burned out and often wondered if they could go on the way they do. Job stress was reported as very or extremely high by 58%. Dissatisfaction was reported by 26% for daily workload, 50% for administrative tasks, and 19% for work-life balance.

Figure 1 shows the cross-country differences in the average digital health score, ranging from 0 to 10, as well as in burnout rates. The Netherlands had the highest mean score (8.1, SD: 1.4), followed by the United Kingdom (7.6, SD: 1.8) and New Zealand (7.6, SD: 1.8). Switzerland (4.1, SD: 2.0) and Germany (3.2, SD: 1.9) had the lowest mean score. Supplementary Figure S7 shows the substantial cross-country differences in burnout self-assessment and burnout-related outcomes. Burnout rates were highest in New Zealand (49%), Canada (46%) and the United States (45%), and lowest in Switzerland (18%) and the Netherlands (12%). Job stress shows high cross-country differences with the highest perceived stress in Germany (73%) and the United States (72%), and the lowest stress rates were found in Switzerland (43%) and the Netherlands (32%). Participants from UK, New Zealand, the Netherlands and Canada reported the most dissatisfaction across workload, administrative work and work-life balance. Supplementary Table S3 shows the three models used to adjust for differences in physician characteristics between countries. Adjusting for age and gender (Model 2), and for age, gender, community type, weekly working hours, number of patients seen per week and per hour, and number of full-time equivalents in the practice (Model 3) did not change the rankings in digital health score and in burnout prevalence.

Figure 2 presents unadjusted stratified analyses between digital health score and burnout and related outcomes. No association was apparent between the digital health score and burnout, perceived work stress, dissatisfaction with time spent on administrative tasks, and dissatisfaction with work-life balance. However, higher digital health scores were linked to greater dissatisfaction with daily workload. This was confirmed by logistic regression (Supplementary Table S5) adjusted for age, gender and country, showing that dissatisfaction with workload was positively associated with the digital health score (OR 1.08 [1.06–1.10]). No associations were found with burnout (OR 0.99), perceived work stress (OR 1.02), dissatisfaction with time spent on administrative tasks (OR 0.99), or dissatisfaction with work-life balance (OR 1.00).

Discussion

The aim of this study was to assess cross-country differences in primary care physician digital health use and burnout and their relationship, using the results of large surveys in 10 OCDE countries. The Netherlands, the United Kingdom, and New Zealand had the highest level of digital health adoption, Switzerland and Germany the lowest. Burnout was most frequent in New Zealand, Canada, and the United States (about 50%), and least common in Switzerland and the Netherlands. We did not find any association between the digital health score and burnout.

Our findings indicate a positive association between dissatisfaction with daily workload and digital health use. This may suggest that while digital health tools are intended to support certain clinical tasks, they could also contribute to a higher workload. For instance, the increased administrative burden associated with use of electronic health records and other digital systems may demand high time spent on documentation, leading to frustration and dissatisfaction among physicians [27]. On the other hand, it is also possible that physicians with heavier workloads are more likely to adopt digital health tools to cope with the demands of their practice [28]. While this dual interpretation of these findings is plausible, it remains speculative, as our cross-sectional data do not allow us to assess the directionality or causality of this association. This underscores the need to further investigate how digital health can be optimized to reduce workload without adding additional stress.

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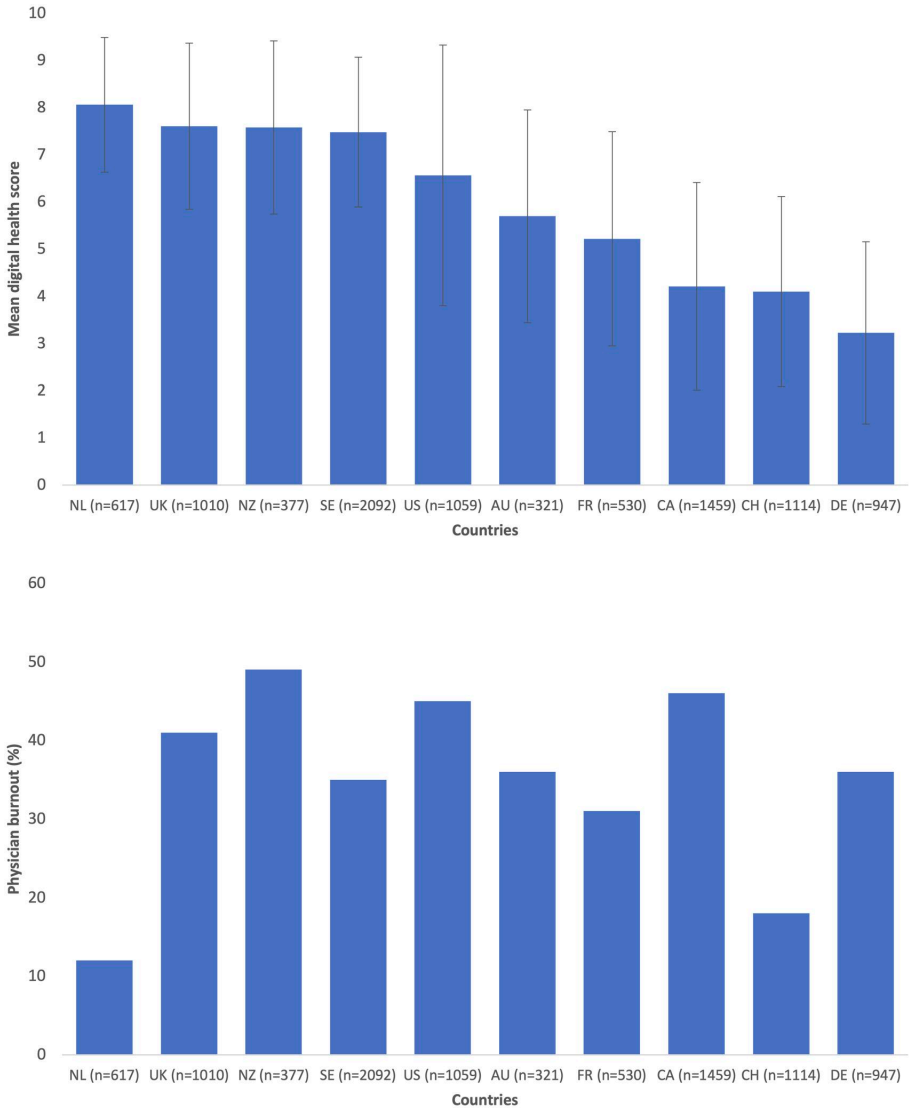

Figure 1. Digital health score and physician burnout by country (Country codes: NL = Netherlands, UK = United Kingdom, NZ = New Zealand, SE = Sweden, US = United States, AU = Australia, FR = France, CA = Canada, CH = Switzerland, DE = Germany). The digital health score is described by mean and standard deviation, and physician burnout is described as percentage of prevalence ($N = 9526$).

Our findings align with previous research. The Bertelsmann Stiftung, an independent foundation that seeks to promote social change, published a ranking identifying the Netherlands, the United Kingdom, and New Zealand as leaders in digital health policy activity and actual use of data [29]. It also identified a combination of structural, institutional, and policy-related factors—including legal frameworks, financing, and the presence of national coordinating agencies—as key contributors to successful digital health implementation. Countries with a stronger institutional anchoring, such as Denmark and the Netherlands, demonstrated higher levels of digital health use. As in the case of Switzerland, the authors suggest that the use of digital health data "is rather low, which is due to the relatively recent implementation of the EPD (Electronic Patient Dossier) law." For low-performing countries to achieve a better adoption and utilization of digital health, this report suggests key factors for a successful implementation: establishing a digital health institution with coordinating power; assuring cooperation among stakeholders; and involving end-users like physicians and patients in the development of tools [30]. Multiple studies have shown that electronic health records, while intended to increase efficiency, may increase administrative burdens and contribute to higher levels of stress among physicians when poorly designed. For example, research has demonstrated that increased time spent on electronic health record tasks is associated with higher levels of burnout and stress [27].

Interpreted through the lens of the UTAUT framework, these results contribute to further hypotheses about the barriers and facilitators affecting digital health adoption among primary care physicians. In terms of performance expectancy, physicians in the countries with high adoption might expect digital tools to enhance their performance

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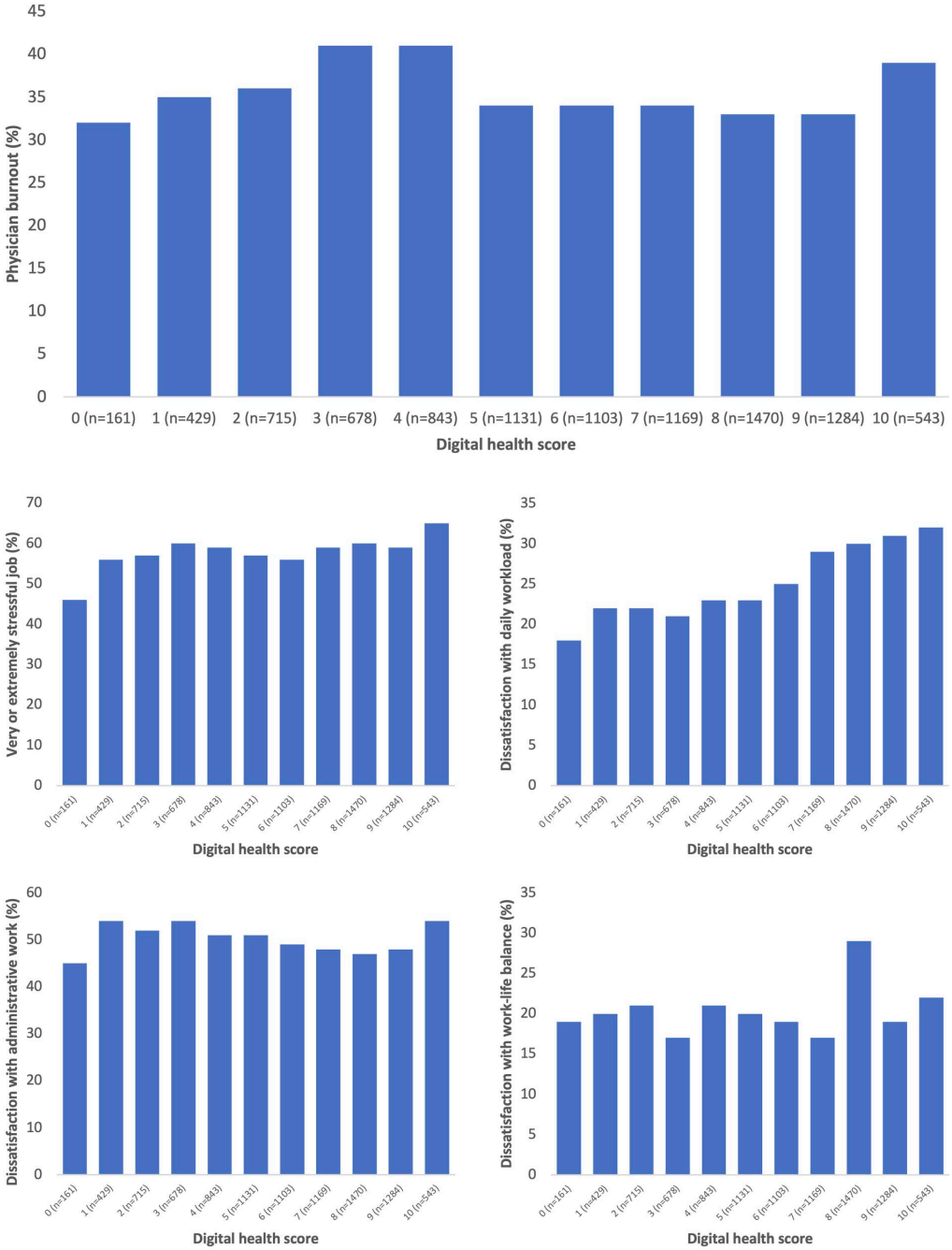

Figure 2. Proportion of physician reporting burnout and burnout-related outcomes by digital health score ($N = 9526$).

by reducing clinical errors or improving patient management. Regarding effort expectancy, our findings show that higher digital health use is associated with lower satisfaction with daily workload. Physicians may find the effort required to use these tools outweighs the perceived benefits, which aligns with the increased dissatisfaction observed. Social influence may also impact adoption, and countries with higher adoption may have stronger cultural and professional norms supporting technology use in healthcare. Finally, facilitating conditions, such as better infrastructure, training, and policy support, are essential for effective adoption.

Our study has several limitations. First, it is a secondary analysis from data not designed to study the relationship between digital health use and burnout. The survey was completed partly online, and the 18% participation rate (excluding Germany) raises concerns

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about participation bias, potentially favoring digitally engaged physicians and underrepresenting those with severe burnout. Second, sampling and participation rates varied across country, potentially introducing a participation bias that differed from one country to the other. Participant characteristics were heterogenous. Third, the digital health score used, while comprehensive and used in a previous study [24], is neither weighted nor validated and may not capture digital health use entirely, such as the quality of the tools used or their integration into clinical workflows. Furthermore, this score mixes different services, and some of its aspects could have opposite effects on the workload of primary care physicians, and, eventually, burnout. For instance, tools such as online appointment scheduling, or electronic prescription renewal may streamline workflows and reduce administrative burden, while other tools like e-mail or web messaging with patients or remote monitoring of chronic conditions may increase workload [31]. Future research should explore this heterogeneity further, potentially by disaggregating the digital health score to better understand the specific associations of its components with physician burnout. Fourth, burnout was assessed with a single self-reported item and did not use more comprehensive tools, such as the Maslach Burnout Inventory (MBI) [32]. As a result, it did not capture the multidimensional and complex nature of burnout [33]. Nevertheless, the burnout rates reported in this study are similar to those reported in other studies, for instance in the USA [34], Canada [35], and in Germany [36]. Fifth, we could not consider in the analysis other potentially important determinants of digital tools use such as level of training, or institutional implementation strategies. Last, we cannot assume a causal relationship between the analyzed variables. Future research should use longitudinal or experimental designs to better assess the directionality of these associations and explore causal pathways and identify interventions easing the implementation of digital tools without increasing the burden of physicians.

In conclusion, our study revealed massive cross-country differences in digital health use and in burnout rates. Burnout and digital health use were not associated. However, the negative relationship between digital health use and physician workload satisfaction might imply that digital health may add to the administrative burden for physicians. If true, this indicates the need for optimization of digital health tools to ensure that they reduce, rather than exacerbate, physicians' workload. Our results suggest that implementation should focus on aligning these tools with physicians' workflows. Policymakers, patients, and healthcare professionals involved in the co-design of such tools may use these results to prioritize strategies that help administrative processes and invest in infrastructures that support user-friendly digital systems. Technology developers could benefit from insights into which features impact workload satisfaction to improve adoption of their tools. These insights can help guide targeted implementation strategies to ensure digital health fulfills its promises without compromising physician well-being.

Author contributions

M.J., V.S., S.T., V.v.W., and A.C. wrote the protocol for the current study based on an idea of M.J., V.S., and A.C. M.J. analyzed the data under the guidance of A.C. and drafted the manuscript with contributions of V.S., S.T., V.v.W., and A.C. All authors revised and approved the final version of the manuscript before submission.

Supplementary data

Supplementary data are available at *EURPUB* online.

Conflicts of interest: None declared.

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- The Dutch Ministry of Health, Welfare and Sport
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Key points

- Substantial European cross-country differences exist in both digital health adoption and burnout.
- Digital health use is associated with dissatisfaction with workload, but nor with burnout or other related outcomes.
- Improvements are needed to optimize digital health to alleviate, rather than exacerbate, physician workload.

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Supplementary Table S1: Target population, random sample, physicians invited to participate, participants (N total = 9526), and participation rate by country. Some values were not available (*NA*).

Country	Target population[a]	Random sample[b]	Non-deliverables and ineligibles[c]	Physicians invited to participate[d]	Participants[e]	Participation rate[f]
Australia	25000	3502	492	3010	321	10,7%
Canada	90000	6478	12	6466	1459	22,6%
France	68196	12650	487	12163	530	4,3%
Germany	26396	NA	NA	NA	947	NA
Netherlands	4800	1600	20	1580	617	39,1%
New Zealand	NA	3936	17	3919	377	9,6%
Sweden	NA	6000	15	5985	2092	35,0%
Switzerland	8354	4000	59	3941	1114	28,3%
United Kingdom	72722	4606	20	4586	1010	22,0%
United States	350000	5852	53	5799	1059	18,3%

a: (approximate) number of potentially eligible physicians per country.
b: random sample of physicians eligible for participation from the study population provided by local health agencies.
c: participants excluded from the random sample.
d: sample after exclusion of non-deliverables and ineligibles.
e: sample who completed the questionnaire.
f: participants divided by the valid sample.

Supplementary Table S2: Characteristics of primary care physicians and practice care settings by country (N = 9526).

		N (%)									
Characteristics		Australia (n=321)	Canada (n=1459)	France (n=530)	Germany (n=947)	Netherlands (n=617)	New Zealand (n=377)	Sweden (n=2092)	Switzerland (n=1114)	United Kingdom (n=1010)	United States (n=1059)
Age [year]	Under 35	14 (4)	259 (18)	102 (19)	22 (2)	27 (4)	17 (5)	289 (14)	33 (3)	226 (22)	52 (5)
	35-44	54 (17)	355 (24)	163 (31)	179 (19)	181 (29)	70 (19)	767 (37)	278 (25)	505 (50)	203 (19)
	45-54	89 (28)	324 (22)	85 (16)	312 (33)	182 (30)	92 (24)	475 (23)	333 (30)	168 (17)	270 (26)
	55-64	107 (33)	316 (22)	141 (27)	340 (36)	196 (32)	144 (38)	351 (17)	318 (29)	87 (9)	287 (27)
	65 or older	57 (18)	197 (14)	39 (7)	94 (10)	29 (5)	54 (14)	210 (10)	152 (14)	24 (2)	241 (23)
Gender	Women	138 (43)	763 (52)	265 (50)	457 (48)	298 (48)	218 (57)	1198 (57)	518 (47)	607 (60)	448 (42)
	Men	181 (56)	688 (47)	261 (49)	490 (52)	314 (51)	158 (42)	894 (43)	596 (54)	401 (40)	590 (56)
	Other	2 (1)	5 (<1)	0 (0)	0 (0)	0 (0)	1 (<1)	0 (0)	0 (0)	2 (<1)	1 (<1)
Community type	Urban	196 (61)	682 (47)	278 (52)	246 (26)	213 (35)	205 (54)	818 (39)	466 (42)	523 (52)	438 (41)
	Intermediate	95 (30)	376 (26)	62 (12)	431 (46)	320 (52)	125 (33)	835 (40)	404 (36)	410 (41)	467 (44)
	Rural	30 (9)	392 (27)	190 (36)	268 (28)	77 (12)	46 (12)	439 (21)	243 (22)	72 (7)	144 (14)
Weekly working hours	Less than 35	129 (40)	214 (15)	81 (15)	58 (6)	68 (11)	159 (42)	640 (31)	287 (26)	406 (40)	146 (14)
	35-44	94 (29)	310 (21)	154 (29)	127 (13)	159 (26)	107 (28)	880 (42)	258 (23)	321 (32)	244 (23)
	45 or more	96 (30)	843 (58)	291 (55)	758 (80)	389 (63)	110 (29)	545 (26)	568 (51)	282 (28)	618 (58)
Number of patients seen per week	Less than 70	62 (19)	421 (29)	58 (11)	27 (3)	110 (18)	178 (47)	1789 (86)	441 (40)	232 (23)	453 (43)
	70-119	86 (27)	489 (34)	234 (44)	95 (10)	233 (38)	142 (38)	232 (11)	418 (38)	384 (38)	408 (39)
	120 or more	171 (53)	444 (30)	228 (43)	769 (81)	264 (43)	56 (15)	0 (0)	251 (23)	390 (39)	139 (13)
Number of patients seen per hour	Less than 2	46 (14)	637 (44)	90 (17)	66 (7)	182 (30)	170 (45)	1813 (87)	638 (57)	169 (17)	708 (67)
	2-4	170 (53)	562 (39)	387 (73)	341 (36)	384 (62)	195 (52)	123 (6)	442 (40)	681 (67)	236 (22)
	4 or more	100 (31)	99 (7)	40 (8)	444 (47)	41 (7)	10 (3)	11 (1)	29 (3)	154 (15)	26 (2)
Number of full-time equivalents in the office	Less than 2	28 (12)	277 (19)	216 (41)	314 (33)	367 (59)	55 (15)	58 (3)	550 (49)	42 (4)	274 (26)
	2 to 3	21 (7)	193 (13)	118 (22)	238 (25)	121 (20)	63 (17)	127 (6)	268 (24)	98 (10)	145 (14)
	3 to 6	127 (40)	418 (29)	173 (33)	210 (22)	114 (18)	157 (42)	723 (35)	214 (19)	505 (50)	282 (27)
	6 or more	153 (42)	529 (36)	23 (4)	44 (5)	11 (2)	102 (27)	1081 (52)	78 (7)	351 (35)	327 (31)

Supplementary Table S3: Digital health score and physician burnout by country*. The digital health score is described by mean and standard deviation, and physician burnout is described as percentage of prevalence (N = 9526).

		Means (SD)	Margins (SD)	
	Countries	Model 1 **	Model 2 **	Model 3 **
Digital health score	NL (n=617)	8.06 (1.43)	8.06 (0.81)	8.02 (0.82)
	UK (n=1010)	7.61 (1.77)	7.61 (0.06)	7.60 (0.06)
	NZ (n=377)	7.58 (1.84)	7.58 (0.10)	7.58 (0.10)
	SE (n=2092)	7.48 (1.59)	7.48 (0.04)	7.51 (0.04)
	US (n=1059)	6.56 (2.76)	6.56 (0.06)	6.54 (0.06)
	AU (n=321)	5.70 (2.25)	5.70 (0.11)	5.68 (0.11)
	FR (n=530)	5.22 (2.27)	5.22 (0.09)	5.20 (0.09)
	CA (n=1459)	4.21 (2.20)	4.22 (0.05)	4.22 (0.05)
	CH (n=1114)	4.10 (2.01)	4.10 (0.06)	4.08 (0.06)
	DE (n=947)	3.22 (1.93)	3.22 (0.07)	3.23 (0.07)
		Prevalence	Margins (SD)	
Burnout	NL (n=617)	12	12 (1)	11 (1)
	UK (n=1010)	41	41 (2)	44 (2)
	NZ (n=377)	49	49 (3)	52 (3)
	SE (n=2092)	35	34 (1)	37 (1)
	US (n=1059)	45	46 (2)	44 (2)
	AU (n=321)	36	36 (3)	40 (3)
	FR (n=530)	31	31 (2)	30 (2)
	CA (n=1459)	46	46 (3)	44 (1)
	CH (n=1114)	18	18 (1)	19 (1)
	DE (n=947)	36	36 (2)	32 (2)

* Country codes: NL = Netherlands, UK = United Kingdom, NZ = New Zealand, SE = Sweden, US = United States, AU = Australia, FR = France, CA = Canada, CH = Switzerland, DE = Germany

** Model 1 was unadjusted, Model 2 was adjusted for age and gender, and model 3 was adjusted for age, gender, community type, weekly working hours, number of patients seen per week and per hour, and number of full-time equivalents in the practice.

Supplementary Table S4: Number of missing and alternative data for each variable (N = 9526). Some data were not available (NA).

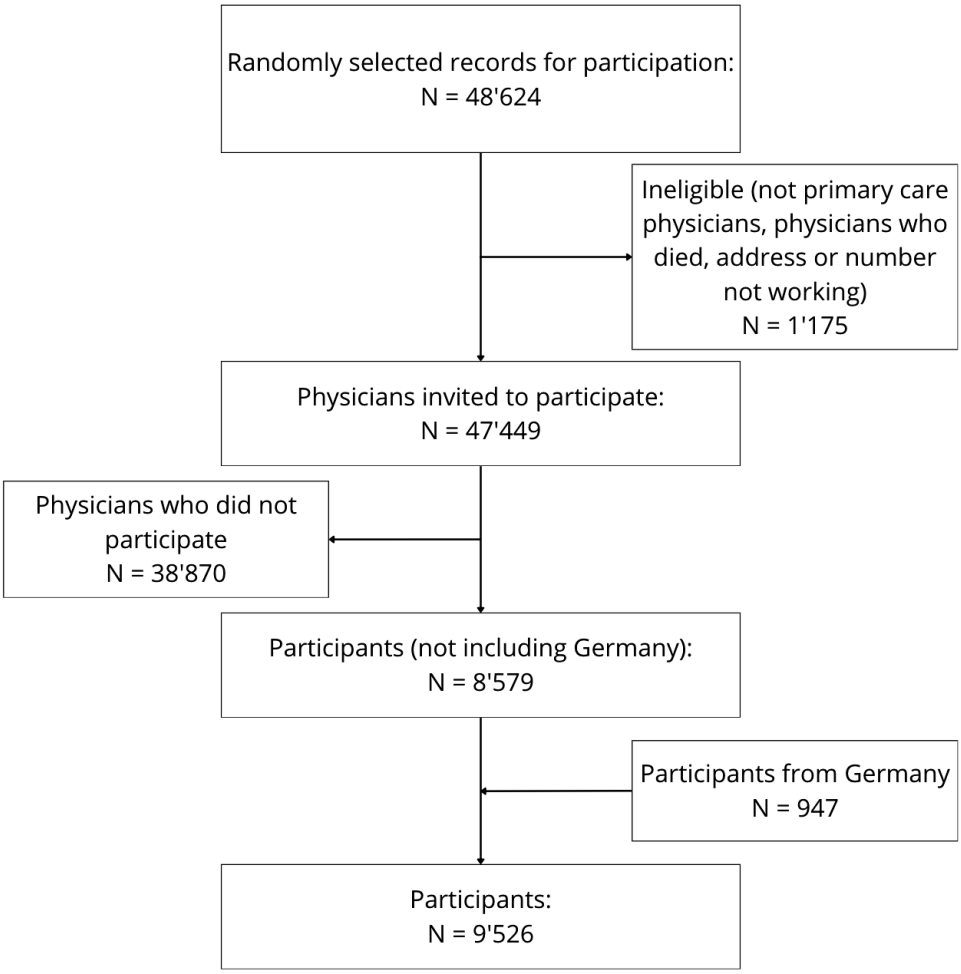
Variable	Missing	Invalid	Multiple-response code	Not sure	Prefer not to answer	Declined to answer
Country	0 (0)	*NA*	*NA*	*NA*	*NA*	*NA*
Age [year]	0 (0)	*NA*	0 (0)	0 (0)	*NA*	16 (0)
Gender	0 (0)	*NA*	0 (0)	0 (0)	10 (0)	22 (0)
Community type	0 (0)	*NA*	16 (0)	0 (0)	*NA*	19 (0)
Weekly working hours	0 (0)	112 (1)	*NA*	*NA*	*NA*	72 (1)
Number of patients seen per week	0 (0)	0 (0)	123 (1)	3 (0)	*NA*	196 (2)
Number of full-time equivalents in the office	0 (0)	5 (0)	7 (0)	10 (0)	*NA*	211 (2)
Percentage of consultations by video	122 (1)	*NA*	*NA*	0 (0)	*NA*	0 (0)
Use of connected health tools to monitor the health of patients with chronic diseases	0 (0)	*NA*	2 (0)	*NA*	*NA*	199 (2)
Use of electronic patient medical records	0 (0)	*NA*	1 (0)	*NA*	*NA*	33 (0)
Possibility to communicate electronically patient clinical summaries	0 (0)	*NA*	1 (0)	254 (3)	*NA*	38 (0)
Possibility to communicate electronically diagnostic and laboratory tests	0 (0)	*NA*	1 (0)	237 (2)	*NA*	38 (0)
Possibility to communicate electronically list of medications	0 (0)	*NA*	0 (0)	282 (3)	*NA*	46 (0)
Practice allowing e-mail or web communications with patients	0 (0)	*NA*	0 (0)	93 (1)	*NA*	36 (0)
Practice allowing online appointment taking with patients	0 (0)	*NA*	1 (0)	274 (3)	*NA*	30 (0)
Practice allowing online medical prescriptions renewal	0 (0)	*NA*	3 (0)	71 (1)	*NA*	33 (0)
Practice allowing online lab results acknowledgement by patients	0 (0)	*NA*	4 (0)	165 (2)	*NA*	48 (1)
Overall, based on your definition of burnout, how would you rate your current level of burnout?	0 (0)	*NA*	32 (0)	0 (0)	*NA*	33 (0)
How stressful is your job?	0 (0)	*NA*	12 (0)	0 (0)	*NA*	57 (1)
Satisfaction with daily workload	0 (0)	*NA*	2 (0)	0 (0)	*NA*	35 (0)
Satisfaction with time spent on administrative work	0 (0)	*NA*	2 (0)	0 (0)	*NA*	38 (0)
Satisfaction with work-life balance	0 (0)	*NA*	0 (0)	0 (0)	*NA*	51 (1)

Supplementary Table S5: Regression between burnout self-assessment and burnout-related outcomes and digital health score (N = 9526), unadjusted and adjusted for age, gender, and country. OR: odds ratio, CI: confidence interval.

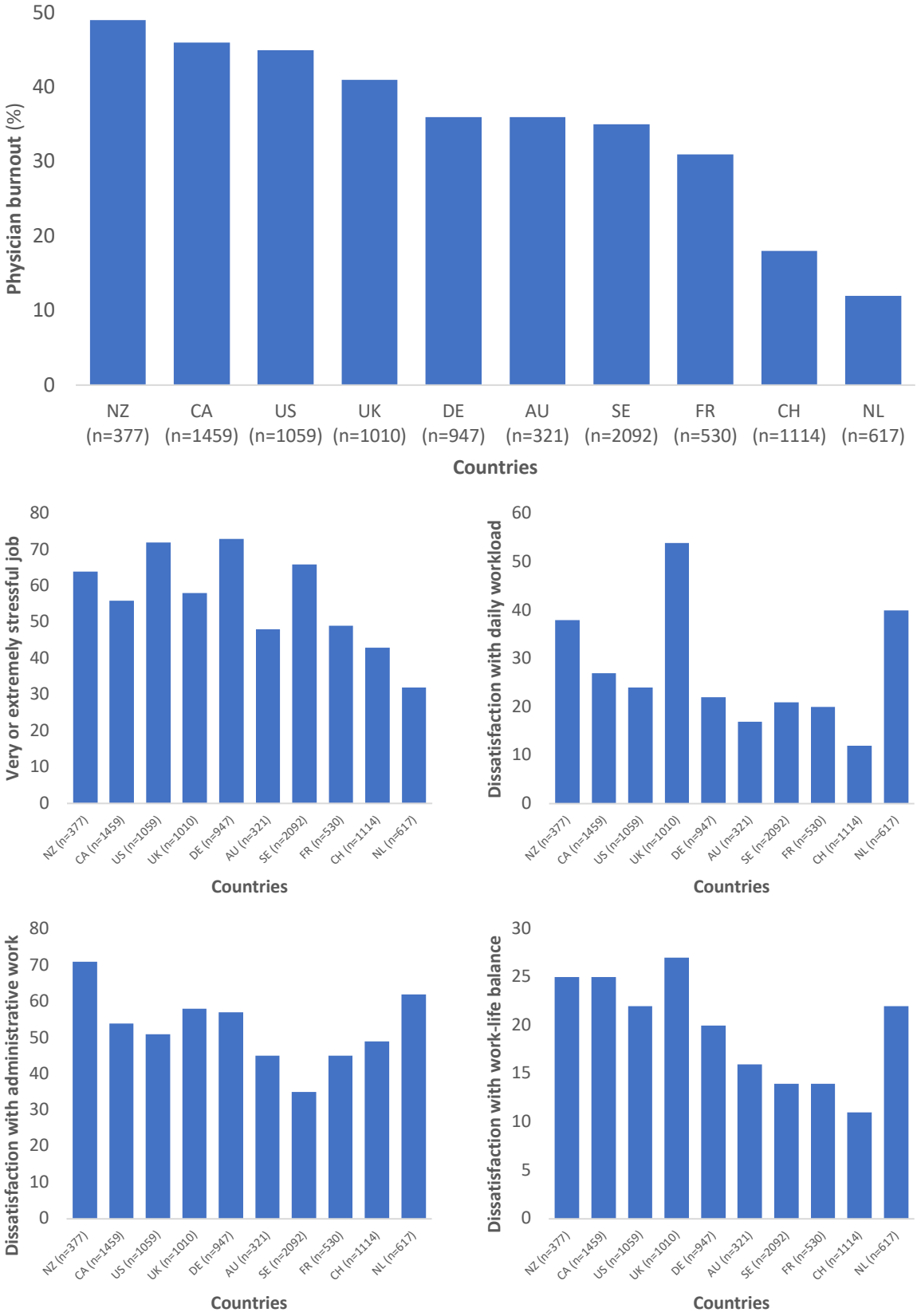
Outcomes	OR* (95% CI)	p value
Unadjusted		
Burnout self-assessment	0.98 (0.97,1.00)	0.054
Perceived stress at work	1.03 (1.01, 1.04)	0.001
Dissatisfaction with daily workload	1.08 (1.06, 1.10)	<0.001
Dissatisfaction with time spent on administrative	0.98 (0.97, 1.00)	0.019
Dissatisfaction with work-life balance	1.00 (0.98, 1.02)	0.861
Burnout self-assessment	0.99 (0.97, 1.00)	0.131
Perceived stress at work	1.02 (1.00, 1.03)	0.074
Dissatisfaction with daily workload	1.08 (1.06, 1.10)	<0.001
Dissatisfaction with time spent on administrative	0.99 (0.97, 1.00)	0.169
Dissatisfaction with work-life balance	1.00 (0.98, 1.02)	0.705

***** A odds ratio greater than 1 indicate a positive relationship between the digital health score (exposure of interest) and the following outcomes: physician burnout, very or extremely stressful job perception, dissatisfaction with daily workload, time spent on administrative work and work-life balance, respectively.

Supplementary Figure S6: Flow chart of the participants (N = 9526).



Supplementary Figure S7: Percentage physician burnout and burnout-related outcomes by country* (N = 9526).



* Country codes: NL = Netherlands, UK = United Kingdom, NZ = New Zealand, SE = Sweden, US = United States, AU = Australia, FR = France, CA = Canada, CH = Switzerland, DE = Germany

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Appendix : Environnement digital et santé des populations

Reference : Jendly, M, Santschi, V, von Wyl, V, Chiolero, A, Environnement digital et santé des populations, Revue Médicale Suisse, 2024. DOI: 10.53738/REVMED.2024.20.870.808.

This thesis is part of a broader reflection on the implications of the digital environment for health. In this article, published in the *Revue Médicale Suisse*, we explored the concept of digital technologies as a new determinant of health, influencing health monitoring and access to care. While digital health holds great promise—such as enabling patient-centered, data-driven, and interprofessional care—it also raises concerns regarding data privacy, equitable access to care, and potential disruptions to the therapeutic relationship.

Environnement digital et santé des populations

MATHIEU JENDLY[a], Pre VALÉRIE SANTSCHI[b], Pr VIKTOR VON WYL[c,d] et Pr ARNAUD CHIOLERO[a,e,f,g]

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La santé et le risque de maladies sont déterminés par l'exposition aux environnements physiques, socio-économiques et politiques, et à cela s'est ajouté l'exposition à l'environnement digital. Notre vie digitale a des implications majeures, d'une part, sur la santé des populations et son monitoring et, d'autre part, sur la prévention et les soins. Ainsi, la santé digitale (digital health), qui englobe l'utilisation d'applications de santé, d'appareils connectés, ou d'outils médicaux d'intelligence artificielle, modifie les pratiques médico-soignantes. Bien utilisée, elle pourrait faciliter les soins centrés sur le patient, interprofessionnels et guidés par les données. Cependant, sa mise en œuvre soulève d'importants craintes et enjeux éthiques en lien notamment avec la protection des données, l'équité et la relation thérapeutique.

Digital environment and population health

Health and risk of disease are determined by exposure to the physical, socio-economic, and political environment and to this has been added exposure to the digital environment. Our increasingly digital lives have major implications for people's health and its monitoring, as well as for prevention and care. Digital health, which encompasses the use of health applications, connected devices and artificial intelligence medical tools, is transforming medical and healthcare practices. Used properly, it could facilitate patient-centered, interprofessional and data-driven care. However, its implementation raises major concerns and ethical issues, particularly in relation to privacy, equity, and the therapeutic relationship.

INTRODUCTION

Dans une approche bio-socio-écologique, la santé et le risque de maladies sont déterminés par l'exposition aux environnements physique, socio-économique et politique (**tableau 1**). À cela s'est ajoutée l'exposition à un environnement digital comme déterminant de la santé des populations. Façonnée par l'activité technologique numérique et par toute forme d'activités digitales, notre vie de plus en plus digitale a des implications majeures, d'une part, sur la santé des populations et son monitoring et, d'autre part, sur la prévention et les soins (**figure 1**). Elle soulève les questions de littératie numérique, de protection des données, d'éthique ou d'équité dans l'accès aux services de santé fournis digitalement.[1]

Élément émergeant de cet environnement digital, la santé digitale (eHealth) est un vaste champ englobant des catégories telles que la santé mobile (mHealth), les dispositifs portables, ou la télémédecine. Elle tire profit de la digitalisation croissante de notre quotidien, via notamment la miniaturisation des senseurs ouvrant la voie à des collectes de données en continu et en temps réel,[2] et les développements de l'intelligence artificielle (IA). Elle change – et pourrait améliorer – les pratiques de prévention et de gestion des maladies.

L'objectif dans cet article est d'examiner certaines implications de l'exposition grandissante à un environnement digital sur le monitoring de la santé des populations et sur les soins, et certaines barrières à l'implémentation des outils de santé digitale sur la base notamment de récentes études menées en Suisse.

IMPLICATION SUR LE MONITORING DE LA SANTÉ DES POPULATIONS

La surveillance sanitaire et le monitoring de la santé des populations reposent sur la collecte, l'analyse systématique et l'interprétation des données, dans le but de les diffuser auprès des personnes et autorités responsables de la prévention et du contrôle des maladies. Ce champ évolue avec les avancées en matière de science des données et d'IA,[3,4] soutenues par

FIG 1 Vie digitale et déterminants de la santé

À l'échelle d'un individu ou d'une population, la santé est déterminée par un ensemble de facteurs qui interagissent entre eux, de manière complexe et dynamique. Ces facteurs sont appelés déterminants de la santé. Ils agissent soit au niveau de l'individu, soit des environnements dans lesquels les individus évoluent. La vie digitale module de plus en plus l'ensemble de ces déterminants.

(*Adaptée et modifiée de réf.*[17]).

[a]Population Health Laboratory (#PopHealthLab), Université de Fribourg, 1700 Fribourg, [b]Institut et Haute école de la santé La Source, HES-SO Haute école spécialisée de Suisse occidentale, 1004 Lausanne, [c]Institute für Epidemiologie, Biostatistik und Prävention, Université de Zurich, 8001 Zurich, [d]Institut für Implementation Science in Health Care, Université de Zurich, 8001 Zurich, [e]Observatoire valaisan de la santé, 1950 Sion, [f]School of Population and Global Health, McGill University, Montreal, QC H3A 0G4, Canada, [g]Berner Institut für Hausarztmedizin, Université de Berne, 3012 Berne
mathieu.jendly@unifr.ch | v.santschi@ecolelasource.ch | viktor.vonwyl@uzh.ch
arnaud.chiolero@unifr.ch

TABLEAU 1 Environnement et risque associé pour la santé

La santé et le risque de développer des maladies sont déterminés par l'exposition aux environnements physique, digital, socio-économique et politique.[1]

	Environnement physique	Environnement digital	Environnement socio-économique	Environnement politique
Définition	• Éléments naturels et construits dans l'environnement • Climat	Environnement construit par l'activité technologique numérique, sur internet et par toute autre forme d'activité digitale	Structures et modes de fonctionnement liés **1.** Aux activités économiques et systèmes de valeurs associés **2.** Aux valeurs sociales des individus ou des groupes	Structures et mode de fonctionnement liés à l'organisation et à l'exercice du pouvoir (lois, règlements, politiques publiques)
Exemples de facteurs pouvant influencer la santé des populations	• Qualité de l'eau, de l'air, du sol • Mode de gestion des espaces naturels (forêt, faune, flore) • Bâtiments, aménagements urbains, voies de communication	• Littératie numérique • Accès et équipement aux technologies numériques • Lien social • Dangers et utilisations problématiques	• Éducation, revenu, richesse • Nourriture saine accessible (prix, disponibilité) • Populations vulnérables (statut socio-économique ou migratoire, nationalité, orientation sexuelle)	• Législation sur le tabac et l'alcool • Coûts de la formation • Systèmes d'assurances sociales • Investissements dans la prévention et la promotion de la santé

des données issues notamment des prestataires de soins dont l'accessibilité et le volume ont fortement augmenté.[5] Ainsi, l'activité hospitalière et ambulatoire génère une quantité considérable de données médico-administratives et épidémiologiques, de plus en plus accessibles et potentiellement utiles pour la surveillance sanitaire.[6]

Parallèlement, de plus en plus de données proviennent directement des patients via des outils connectés et des applications de santé. En 2022, 51% des personnes en Suisse avaient la possibilité de suivre leur nombre de pas et 28% utilisaient quotidiennement des outils digitaux à des fins de santé.[7] De nombreux patients atteints de maladies chroniques utilisent ces outils. Par exemple, dans un collectif de patients avec diabète en Valais, nous avons observé que 44% utilisaient des outils de santé connectés (traqueur d'activités, balance connectée ou glucomètre connecté) et que 43% utilisaient des applications de santé.[8] Dans une cohorte de patients avec sclérose en plaques en Suisse, près de 8/10 utilisaient au moins une fois par semaine des smartphones, des applications pour mobiles et tablettes, l'internet en général, ainsi que des applications de messagerie électronique; 1/10 représentait des utilisateurs plus assidus et 1/10 l'était moins.[9]

Ces nouvelles données pourraient permettre, d'une part, de renforcer la surveillance sanitaire de la population, et, d'autre part, d'améliorer le suivi de patients au niveau individuel. Toutefois, davantage de données ne garantissent pas nécessairement une augmentation correspondante des informations utiles pour la prise de décision en santé publique ou en clinique. Ainsi, la qualité de ces données est souvent problématique car elles ne sont pas collectées de manière standardisée et proviennent de populations aux contours mal définis.[6] En utilisant les données des prestataires de soins (hôpitaux, médecins installés, pharmaciens), on se limite aux cas diagnostiqués et pris en charge par ces prestataires, mais sans informations relatives aux cas non diagnostiqués, ce qui conduit à des biais de surveillance.[10] À cela s'ajoutent les problèmes, d'une part, d'interopérabilité qui peut fortement limiter la comparabilité des données entre différentes institutions et, d'autre part, de protection des données et des droits à les exploiter et diffuser. Ces éléments sont des facteurs très limitants actuellement dans l'emploi de ces données au-delà de leur usage primaire.

IMPLICATION ET BARRIÈRES À LA DIGITALISATION DANS LES SOINS

Les implications des technologies digitales pour les soins sont multiples et il est impossible ici d'en faire une revue exhaustive.

Si l'on demande à ChatGTP ce qu'il en pense (**encadré 1**), le potentiel des technologies digitales semble considérable au vu de la diversité des services proposés par la santé digitale. L'IA est ainsi de plus en plus présente en clinique, par exemple, pour analyser des électrocardiogrammes[11] ou des images radiologiques.[12] Les «Large Language Models» (LLM), une sous-catégorie de l'IA à laquelle appartient ChatGPT, ont ouvert d'autres possibilités dans le contexte clinique et pour le soutien administratif, par exemple, pour la rédaction de courriers comme les lettres de sortie, sans éluder qu'un tel emploi pose des problèmes potentiellement majeurs de perte de confidentialité et de propriété des données. On peut enfin évoquer l'emploi des technologies digitales pour renforcer l'implication du patient dans sa prise en charge.

Toutefois, l'enthousiasme pour ces outils ne doit pas nous aveugler sur le fait que leur implémentation soulève encore beaucoup de questions et de difficultés. Il faut apprivoiser ces outils alors qu'il y a de nombreuses barrières à la digitalisation, qu'elles soient structurelles et organisationnelles, au niveau des professionnels de la santé ou des patients.

Encadré 1. Question à ChatGPT

«Explique-moi les domaines d'application de la santé digitale en termes d'applications de santé, d'objets connectés, de télémédecine et d'autonomisation du patient.»

«La santé digitale englobe plusieurs domaines d'application essentiels:

1. **Les applications de santé**: les applications mobiles et web dédiées à la santé permettent aux utilisateurs de surveiller leur condition physique, de suivre leur alimentation, de gérer leurs médicaments, de mesurer leur activité physique, et d'accéder à des informations médicales précises. Ces applications aident les individus à maintenir un mode de vie sain.

2. **Les objets connectés**: les dispositifs connectés tels que les montres intelligentes, les tensiomètres, les glucomètres et les balances, collectent des données physiologiques en temps réel. Ces données sont ensuite transmises à des applications ou à des plateformes en ligne, offrant aux utilisateurs un suivi continu de leur santé et de leur bien-être.

3. **La télémédecine**: la télémédecine permet aux patients de consulter des professionnels de la santé à distance, généralement via des consultations vidéo ou des applications spécialisées. Cela facilite l'accès aux soins médicaux, en particulier pour les personnes vivant dans des régions éloignées ou ayant des besoins de suivi régulier.

4. **L'autonomisation du patient**: la santé digitale donne aux individus un rôle actif dans leur propre santé. Ils peuvent accéder à des informations médicales, surveiller leur condition, participer aux décisions de traitement et communiquer plus efficacement avec les professionnels de la santé.

Ces domaines d'application de la santé digitale contribuent à améliorer la gestion de la santé personnelle, à rendre les soins de santé plus accessibles et à encourager une plus grande implication des patients dans leur bien-être.»

Barrières structurelles et organisationnelles

On peut, par exemple, évoquer le manque d'intégration des outils de santé digitale. En effet, la grande majorité des outils utilisés par les patients ne s'intègrent pas aux systèmes d'informations sanitaires, par exemple via les dossiers médicaux électroniques.[13] Alors que l'un des objectifs de la digitalisation est de faciliter le partage entre patients et professionnels de la santé, cette absence d'intégration implique que ce qui est fait par l'un est souvent inaperçu par l'autre. Cela empêche aussi l'exploitation de ces données au-delà de leur usage primaire. On peut aussi évoquer que ces technologies ont des coûts et que se pose la question de leur financement. Un problème majeur est que nous manquons d'évidence pour évaluer leur utilité et leur balance bénéfices-risques. En effet, les outils de monitoring, de diagnostic et les IA médicales ne font pas systématiquement l'objet d'évaluation, par exemple dans le cadre d'essais cliniques évaluant leur efficacité et sécurité, par analogie avec ce que l'on fait pour les médicaments. D'autres facteurs limitants sont les problèmes en lien avec la protection et le partage des données, et la qualité de ces dernières. Il y a des problèmes qui sont loin d'être résolus en lien avec la propriété, la sécurité et la confidentialité des données.

Barrière au niveau des professionnels de la santé

Les professionnels de la santé jouent un rôle clé dans l'adoption de nouvelles technologies. Or, nombreux sont ceux qui ne les maîtrisent pas, ce qui limite leur implémentation. Un autre frein est la préoccupation que ces technologies augmentent, du moins initialement, la charge de travail administratif. Certains professionnels de la santé craignent également qu'elles ne déshumanisent les soins et nuisent à la relation avec le patient.[13] Cependant, s'ils sont bien conçus, ces outils pourraient permettre aux médecins de consacrer plus de temps à leurs patients, par exemple en les soulageant de tâches administratives. Les patients semblent d'ailleurs moins réticents à l'adoption de ces technologies que ne le croient les professionnels de la santé. Dans une étude réalisée en Suisse pour évaluer l'emploi de capteurs de mouvements à domicile, les personnes âgées et leurs proches étaient plus enthousiastes que les soignants quant à ce que ces technologies pouvaient apporter.[14] Une étude réalisée en Allemagne a indiqué que plus de la moitié des patients considéraient l'IA comme positive, voire très positive, alors qu'ils étaient moins de 5% à la juger négative, voire très négative.[15]

Barrière au niveau des patients

Les aspects techniques tels que la difficulté d'utilisation ou la peur de la technologie sont des obstacles fréquemment cités, tout comme une faible littératie numérique, un âge avancé, un manque d'intérêt ou les troubles cognitifs. Un accès limité à ces technologies en raison du coût constitue aussi certainement un obstacle à leur adoption,[13] mettant en exergue la question de l'équité dans l'accès aux soins qui pourrait être péjorée par les nouvelles technologies. Cela crée un paradoxe car les personnes âgées ou celles ayant un statut socio-économique plus bas ont moins recours aux technologies de la santé, bien qu'elles aient des besoins de soins plus importants (**encadré 2**). En Suisse, l'âge et le niveau de formation sont aussi des prédicteurs importants de l'utilisation des technologies de santé dans la population générale[7] ou auprès des patients atteints de maladies chroniques (**figure 2**).[8] Les politiques de promotion de la santé digitale doivent tenir compte de cette fracture socio-économique dans la santé digitale.[16]

Encadré 2. Loi inverse des soins et fracture numérique

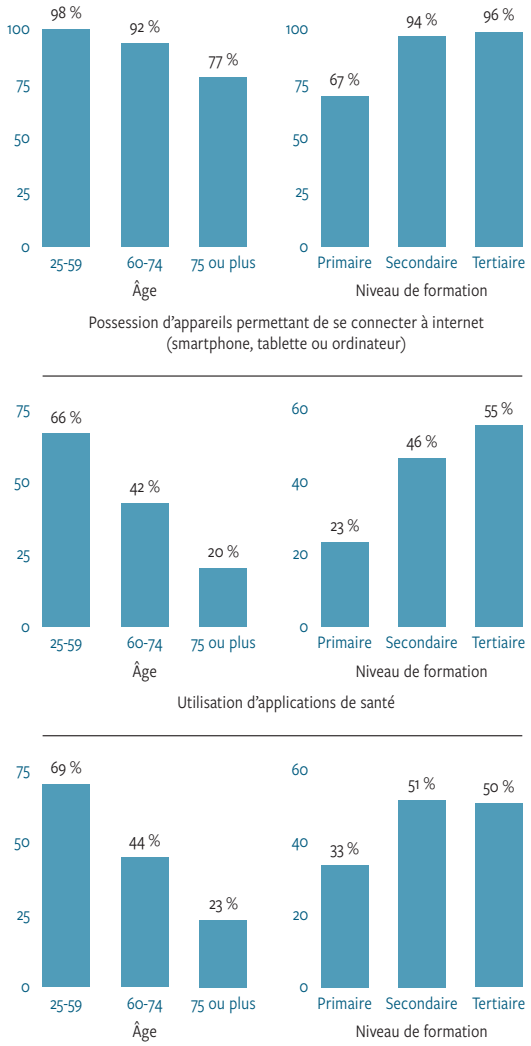
La loi inverse des soins (inverse care law) souligne que «la disponibilité de soins médicaux de qualité est inversement proportionnelle aux besoins de la population desservie». Elle décrit le paradoxe selon lequel les individus ayant le plus grand besoin de soins médicaux sont fréquemment ceux qui en reçoivent le moins. Cette situation découle en partie de l'accès limité aux prestataires de soins et à la prévention, perpétuant ainsi un cycle d'inégalités en matière de santé.[18] La fracture numérique (digital divide), qui désigne les inégalités dans l'accès aux technologies de l'information et de la communication, est une confirmation de cette loi.[19] En effet, un âge avancé et un statut socio-économique modeste sont associés à un risque augmenté de maladies et une plus faible utilisation des outils de santé digitaux, comme le prédit la loi inverse des soins.

CONCLUSION

Les transformations induites par l'environnement digital sur la santé des populations et son monitoring ainsi que sur les soins sont considérables. L'essor de la santé digitale ouvre de nouvelles perspectives pour la prévention et la

FIG 2 **Profil de santé digitale des patients avec diabète**

En fonction de l'âge et du niveau de formation, dans une cohorte en Valais (n = 398).[8]



gestion des maladies ainsi que pour la surveillance sanitaire. Le futur de la santé publique et des soins sera de plus en plus digital. Néanmoins, pour que les bénéfices potentiels se réalisent, il nous faut plus de preuves quant à l'utilité, la fiabilité et la sécurité des outils de santé digitale, renforcer leur intégration dans des systèmes d'information sanitaire et former les professionnels de santé à leur emploi. Les problèmes encore majeurs en lien avec la propriété, la sécurité et la confidentialité des données ainsi que les questions d'équité et d'accès aux technologies doivent aussi être adressés avec attention.

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ORCID ID:
M. Jendly: https://orcid.org/0009-0004-9738-7551
V. Santschi: https://orcid.org/0000-0002-4452-8857
V. von Wyl: https://orcid.org/0000-0002-8754-9797
A. Chiolero: https://orcid.org/0000-0002-5544-8510

IMPLICATIONS PRATIQUES

- La digitalisation croissante de notre environnement et l'utilisation des nouvelles technologies ont des impacts sur la santé des populations et son monitoring.
- Les outils de santé digitale pourraient permettre une meilleure gestion des maladies mais il faut évaluer leur efficacité, leur fiabilité et leur sécurité.
- Les professionnels de la santé devraient être formés aux nouvelles technologies de santé digitale afin d'en tirer le meilleur parti et d'apprécier leur potentiel impact et leurs limites sur la pratique médicale.
- Les problèmes encore majeurs en lien avec la propriété, la sécurité et la confidentialité des données ainsi que les questions d'équité et d'accès aux technologies doivent être adressées avec attention.

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