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COVID-19 and digital competencies among young physicians: are we (really) ready for the new era? A national survey of the Italian Young Medical Doctors Association

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Abstract

Background. Digital health (DH) is nowadays fundamental for physicians. Despite the improvement of information and communications technology (ICT), Italian medical doctors' (MDs) education system seems inadequate in this area. Moreover, due to the COVID-19 pandemic, societies are waking up to their limitations. The aim of this paper is to analyze the Italian *status quo* in DH.

Methods. The Italian Young Medical Doctors Association (Segretariato Italiano Giovani Medici - SIGM) proposed a web-based survey to assess DH awareness and previous knowledge among young doctors. Investigated areas were: big data, -omics technology and predictive models, artificial intelligence (AI), internet of things, telemedicine, social media, blockchain and clinical-data storage.

Results. A total of 362 participants answered to the survey. Only 13% had experience in big data during clinical or research activities, 13% in -omics technology and predictive models, 13% in AI, 6% had experience in internet of things, 22% experienced at least one telemedicine tool and 23% of the participants declared that during their clinical activities data collection was paper-driven.

Conclusions. Three categories of MDs, high-tech, low-tech and no-tech, can be identified from the survey-based investigation. Our survey's results indicate an urgent need for integration of pre- and post-graduation training in digital health to provide adequate medical education.

Key words

- medical education
- information technology
- artificial intelligence
- innovation
- digital health

INTRODUCTION

Contemporary healthcare has very tight relations with digital technology: from clinical data storage and data analysis to communication procedures, medical doctors (MDs) need to interact more with digital devices every day. Digital health (DH) represents the bridge between digital technology, healthcare and society able to enhance healthcare delivery effectiveness [1] and make medicine more personalised and precise [2].

Being a wide and heterogeneous topic, DH started

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with the gradual conversion of patients' data from physical to digital electronic records [3], until digital medical record (DMR) became the primary mode of nonverbal communication [4]. The accuracy and speed of digital computing gave the opportunity to store and systematically analyze a huge amount of clinical data, opening two innovative fields: big data analysis, empowered by distributed learning [5], and the -omics approach, ranging from genomics [6] to radiomics [7]. In this scenario, a monodisciplinary information and communications technology (ICT) approach is not enough: a cross-cutting figure with a medical background and DH skills is required to construct – for instance – large databases within a multicenter consortium or to validate high-tech DH tools [8-10]. Moreover, as it is the case of companies from other fields, healthcare institutions digitalisation must be guided by dedicated professionals such as a chief digital officer (CDO). However, considering the complexity of health workflow and the need for clinical pathways decision-making, the CDO should have a medical background [11].

Another topic of DH is artificial intelligence (AI) [12]. From pattern recognition [13] to process identification and enhancing [14], AI is remarkably interesting for every scientist or high-tech company. However, a major challenge of AI consists in the operators' frequent unawareness of the process that leads to the results: can we trust an algorithm to "decide" a treatment without a full understanding of it? AI is, therefore, a hot topic also for ethical reasons, as documented by the "Rome call for AI Ethics", a declaration subscribed by some of the world's biggest companies and the Pontifical Academy for Life, where a new term has been coined to identify the application of ethics within the algorithm: the "algor-ethics" [15].

Moreover, DH is not only composed of several high-tech tools for predictive models, but allows personalised clinical choices and empowerment of the clinical human intelligence. Several applications are developed every day for communication and tele-consultation and specific companies are created to provide online services for distant medical evaluation of the patients and e-health [2, 16].

Furthermore, in the face of the COVID-19 pandemic, societies are waking up to the limitations of their health care system [17]. In this context, DH role in providing tools, instruments and services could be noteworthy: from AI applications [18] to the opportunity of proposing video consultation instead of the traditional clinical examination in order to contain the infectious risk [19].

DH relevance is growing rapidly. Therefore, governments and companies should invest a consistent share of their resources in it and steer political choices in its favor [20]. In addition, much literature shows the impact of high-tech research in medicine [21]. Therefore, a digital-skilled profile is advisable for any professional involved in healthcare [22-27]. Despite its exponential growth in complexity, currently a specific training course in DH is not sufficiently provided in MD graduation programs yet [28-30].

To the best of our knowledge, there are no scientific experiences reporting the Italian situation in terms of competences acquired in DH for junior MDs, who should become leading actors in the digitalisation of Italian healthcare. In order to promote an adequate DH education, a National project called VALIDATE Project (Value-bAsed Learning for Innovation, Digital health and Artificial inTelligencE) has been launched. It has also been recognised by the Italian Ministry for Innovation and Digitalisation. As a first step for this project, the current condition of DH awareness needs to be assessed, especially for young MDs who represent the future of Italian National Health Service (NHS). Moreover, this project pursues the will of EU Commission and EU Universities stakeholders to promote digitalisation in medical education [31].

The aim of this paper is to analyse the Italian *status quo* regarding DH medical education to identify any critical issue and to propose adequate improvement strategies.

METHODS

Survey

The Digital Health Task Force of the Italian Young MDs Association (Segretariato Italiano Giovani Medici – SIGM), within the VALIDATE Project (Value-bAsed Learning for Innovation, Digital health and Artificial inTelligencE), proposed a survey to recognise and describe the *status quo* of awareness and training in terms of DH and innovation technology.

From 12 to 19 February 2020, a cross-sectional, multicentre survey was conducted, thought, validated and anonymously self-administered through an online questionnaire to Italian young medical doctors.

The eligible people for the survey were: Italian medical students in the last two years of their studies, young medical doctors aged <35 years (including newly-graduated medical doctors), medical residents and specialized MDs (residency obtained within 3 years) in all medical fields as well as general practitioner (GP) trainees and GPs (diploma obtained within 3 years), practising in all Italian regions.

The survey was composed of 21 questions, organised into seven thematic areas where the first area explored the general characteristics of participants such as I) title, discipline and University. The next areas investigated awareness and knowledge about II) big data; III) -omics technology and predictive models; VI) artificial intelligence (AI); V) internet of things; VI) telemedicine, and finally VII) social media, blockchain and clinical-data storage.

For each section, 3 questions were explored: 1) knowledge about clinical applications of that specific technology into their medical area of interest; 2) experience of colleagues working in that field; 3) direct involvement in clinical or research activities into that field.

Development of the questionnaire was informed by a literature review whereas content validity was tested through online discussion and by collecting feedback from external experts. Previous to the launch of the survey, the questions were also pilot tested among 10 young doctors. The questionnaire was developed on SurveyMonkey (SurveyMonkey Inc., San Mateo, CA, USA) and was distributed via mailing list and social

media (Facebook, Whatsapp, website) of the SIGM network. Convenience sampling was chosen for the study, according to the nature of the study population and considering the impossibility of adopting different sampling strategies.

Statistical analysis

The results were reported with a descriptive analysis and further discussed within the Digital Health Task Force of SIGM in a dedicated web conference. The nature of the study (pilot), the potentially small sample size due to the recruitment method, as well as the objective of the study itself, which aims to offer a qualitative description of the results, led to not considering further statistical analysis from the accrued sample.

RESULTS

Within the study period (from 12 to 19 February 2020), the survey was proposed to 401 young medical doctors or medical students by mail. The number of users reached through social media is not strictly quantifiable, making it impossible to calculate the total response rate. A total of 362 Italian young medical doctors completed the survey.

More than half of them (57.2%, n. 206) were resident MDs, while 13.8% (n. 50) were MDs without any further post-graduated training course, 9.7% (n. 35) were medical students, 9.4% (n. 34) were specialist MDs, 6.9% (n. 25) were general practitioners (GP) in training, 1.7% (n. 6) were MD doctor of philosophy (PhD) students, and 1.4% (n. 5) were GPs (*Table 1*).

Participants were from all Italian regions, with 92.8% of Italian Medical Schools represented with at least one participant. Participants' medical background was heterogeneous: among the 52 different medical disciplines recognised in Italy, 79.2% were represented at least by one participant; intensive and critical care (14.2%), radiotherapy (6.9%) and Public Health (6.1%) were the most frequent ones.

Participants' answers to sections from II to VI are shown in *Table 2*.

Almost 39% (n. 141) of participants declared to have knowledge about clinical applications of big data into their medical area of interest, only 26% (n. 95) of participants had experience of colleagues working in the field of big data and 13% (n. 47) reported to be directly involved in the management of big data in daily clinical and research practice.

As for omics and predictive models, 30% (n. 107) of participants stated to have knowledge of these applications in their area of medical interest and the same trend of the previous domain was also shown in reporting both experiences of colleagues working in that field (27%, n. 99) and direct involvement in clinical or research activities (13%; n. 46).

About half of respondents (43%, n. 156) declared to have knowledge of AI appliance in their area of interest. The percentage of respondents decreases in reporting colleagues' experience (27%, n. 96) or direct involvement (13%, n. 46) in AI in daily clinical and research activities. The percentage of responders with knowledge, direct or indirect involvement in the field of internet of things were low, 20% (n. 71), 6% (n. 22) and 10% (n. 38) respectively. The questionnaire results showed that about half of the responders (53%, n. 191) have knowledge about telemedicine and its appliance to their discipline even if the rates of direct appliance (22%, n. 79) and indirect involvement (34%, n. 122) are lower than the median percentage.

Moreover, most of the participants seemed to deem relevant social media tools (82%, n. 294) in their work activities while a lower percentage was obtained regarding the relevance of blockchain tools (54%, n. 194).

In conclusion, junior doctors participating to the survey showed a heterogeneous practice in clinical-data storage tools use (*Figure 1*). Although the majority of participants declared to use electronic archives for clinical activities (76%, n. 274), only a few (8%, n. 28) reported to have the opportunity to share clinical data in a multicentre-based storage system.

Table 1
General description of survey participants

Survey responders		**362**
Region	Abruzzo	3
	Calabria	13
	Campania	33
	Emilia-Romagna	45
	Friuli-Venezia Giulia	1
	Lazio	114
	Liguria	1
	Lombardia	33
	Marche	1
	Piemonte	16
	Puglia	14
	Sardegna	6
	Sicilia	12
	Toscana	2
	Umbria	27
	Veneto	4
	Not specified	37
Status	Student	35
	Medical Doctor (MD)	50
	Resident MD	206
	General practitioner in training	25
	Consultant	34
	General practitioner	5
	MD and PhD	6
	Not specified	1

DISCUSSION

This study represents a first attempt to investigate digital health knowledge in the heterogeneous world of Italian young MDs. The survey involved 362 young MDs in only 7 days, highlighting the strong interest and the relevance of the topic in this generation of professionals. However, results revealed a medium-low knowledge in the areas investigated with percentages ranging from 20% (knowledge regarding the applications of the internet of things) to 53% (knowledge of the application of telemedicine). A lower percentage was observed when the experience or the direct involvement of colleagues was investigated.

Results regarding the use of AI or blockchain are consistent with those emerging from a survey administered

Table 2
Survey results. Dimensions and percentages

	Big Data	-Omics and predictive models	Artificial intelligence	"Internet of things"	Telemedicine
	Answered "Yes" (%)	Answered "Yes" (%)	Answered "Yes" (%)	Answered "Yes" (%)	Answered "Yes" (%)
Knowledge about clinical applications of that specific technology into their medical area of interest	141 (39)	107 (30)	156 (43)	71 (20)	191 (53)
Experience of colleagues involved in that field	95 (26)	99 (27)	96 (27)	38 (10)	122 (34)
Direct involvement in clinical or research activities into that field	47 (13)	46 (13)	46 (13)	22 (6)	79 (22)

in 2019 by the American Medical Association (AMA) in which doctors affirm to be familiar with these tools but only a few uses them [32]. Furthermore, we observed that young Italian doctors are more involved in the use of telemedicine tools and these results recall the ones published by AMA through its recent survey [32].

Moreover, in contrast with what would be expected according to the young target of this study, a homogeneous and clearly recognisable group was not identified. To exemplify, three different subcategories of MDs could be identified from what they answered to the survey. We could recognise: 1) high-tech junior MDs with relevant interest, knowledge and involvement in DH and innovation, that have seen and experienced new technologies in their clinical or research setting; 2) low-tech junior MDs, that seems to have had indirect involvement and not yet experienced the digital revolution in medicine; 3) no-tech junior MDs, who have just had a classic knowledge without any direct or indirect experience of DH.

Surprisingly, most of young MDs participating to the survey can be represented by the last two categories, demonstrating that giving a medical training to a digital native person does not necessarily mean to train a digital MD: to obtain a digital MD, a dedicated training with specific core competencies is needed.

According to the results of this survey, considering the above categories, diversity in digital skills training must be considered and promoted [31]. To propose specific high-level education for selected MDs and to allow a complete generalized digitalisation of healthcare, two different training pathways would be recommended.

It would be beneficial to teach a dedicated core curriculum, with tight interconnection with other technical domain professionals (engineers, physicist, statistics, mathematics etc.). This future category of professionals has the responsibility: 1) to build a new semiology related to the tele-consultation, defining indications and contraindications of a telematic access to healthcare services rather than the traditional clinical evaluation; 2) to identify strong criteria for predictive models (-omics or AI based models) to be safely integrated in the routinely clinical practice; 3) to standardise the system of building clinical and research database storages; 4) to delimitate social network and new communication technologies within healthcare services. The task described above must not be left to the interest of the individual: a dedicated training is needed. On the other hand, in the third millennium a young MD unable to use technology is not more desired. With the rapid diffusion of new communication systems and with a general implementation of telemedicine, that is a global ongoing process, every MD should be trained to perform a tele-consultation (and therefore to know which semeiotic have to

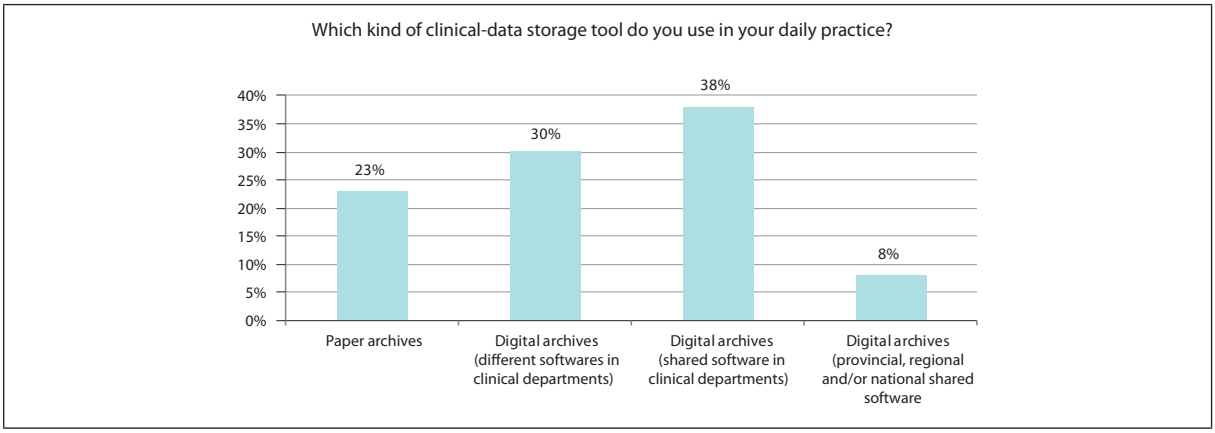

Figure 1
Answers on clinical-data storage tools.

be considered in that scenario); every MD should know which model (including -omics and AI models) is applicable to the different clinical settings and if it is reliable or not, which tool could be used or have to be recommended to give some information to the patients or to receive patient's communications, how to contribute with data acquired during their clinical activities to the main large database that will be available in next future.

To the best of our knowledge, only few papers analysed the *status quo* of junior MDs education in terms of DH education perspectives, but the few pieces of evidence in scientific literature highlight the lack of pre- and post-graduation specific training in DH [33, 34]. As reported by Jidkov *et al.*, in the United Kingdom (UK) health informatics training needs to be soon integrated [28], but a larger international evaluation needs the systematic assessment of the possibility to include DH skills for each medical education model. A professional with these skills needs to be also recognised in order to allow adequate healthcare workforce planning and to promote the role of chief digital officers within healthcare organizations [35]. Moreover, COVID-19 is turning out as a tremendous opportunity to accelerate this transformation both at cultural and at organizational level: we are learning the lesson of unpreparedness and we need to reinvent our way to provide healthcare.

According to the evidence added by this paper, it is urgent for the Italian NHS and for the Italian medical education system to define two different *core curricula*: the first one includes every skill or competence that MDs need for their clinical activities; the second one consists of a comprehensive *core curriculum*, for MDs that want to perform high-level research in DH or participate to the clinical definition of the semeiotic 2.0. The recent evolution of the Italian accreditation system of residential courses for MDs [36] is a useful framework to introduce, *inter alia*, the minimal requirement in terms of competences in DH.

The identification of MDs training as a critical control point is part of the strategic vision of the VALIDATE Project: the main bottleneck in health digitalization is not infrastructural, according to the fact that almost every physician owns a personal computer, but cultural and related to specific competencies.

Moreover, accordingly to the VALIDATE Project aims, a systematic definition of a comprehensive DH core curriculum for MD is required. The methodology of this educational training has to be related on one hand to the clinical setting of the trainee MD and, on the other hand, to the complex institutional framework where the training experience is inlaid (e.g. pre-/post- graduation training, residency, general physician course, continuous medical education, others). For MDs with high-tech features, a second dedicated training program should be defined, preferably implemented in a PhD course or a specific master.

This study has many limitations. First, the sample size and the sampling methods do not ensure the representativeness of all the Italian young medical doctors category; moreover, the modality of recruitment does not allow to analyse the relationship between total respondents and involved users. Second, as with most surveys, there is a possibility that respondents gave socially desirable answers. To minimise this potential bias, we ensured complete respondent confidentiality. Finally, questions about personal experience are subject to recall bias. Despite these limitations, this survey represents a systematic attempt to underline specific needs in Italian medical education.

However, this survey should be considered as an initial mapping to investigate the phenomenon of digital health in Italy among young doctors. It would be suitable in the future to further investigate medical doctors' awareness and propensities to DH, extending this investigation to senior doctors as well since they currently represent the largest slice of the Italian Health workforce.

In conclusion, in the era of evidence-based medicine, allowing improvements in DH only as an individual and spontaneous attitude is no more sustainable: the present and future of digital health education needs a strategic plan that encompasses training starting during healthcare education [33] and continues with a lifelong learning approach [31].

Conflict of interest statement

All the authors have no competing interests.

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Authors' contribution

All the Authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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