

# Education in Health Informatics: Perspectives from the Italian Society for Biomedical Informatics (SIBIM)

Lucia SACCHI<sup>a,b,1</sup>, Gabriella BALESTRA<sup>a,c</sup>, Pierangelo VELTRI<sup>a,d</sup>, Mauro GIACOMINI<sup>a,c</sup>

<sup>a</sup>*Società Italiana di Informatica Biomedica (SIBIM)*

<sup>b</sup>*University of Pavia, Pavia, Italy*

<sup>c</sup>*Politecnico di Torino, Torino, Italy*

<sup>d</sup>*University of Calabria, Rende, Italy*

<sup>e</sup>*University of Genova, Genova, Italy*

**Abstract.** The evolution of socio-technological habits together with the widespread demand of post-acute and chronic treatments outside hospital boundaries drove the increased demand of medical informatics experts to develop tools for and support healthcare professionals. The recent COVID-19 pandemic further highlighted the need of physicians able to manage diseases virtually and remotely. Moreover, healthcare professionals need to access to innovative techniques and procedures to manage biomedical data, cloud-based communication, and data sharing procedures, often connected to innovative devices to support an effective precision in the health treatments. In this paper we report the experiences of the Italian Biomedical Informatics Society (SIBIM), in the definition and promotion of eHealth educational topics in medical and health professions teaching programs, as well as in bioengineering schools, showing how SIBIM members' efforts have been applied towards increasing the level of eHealth contents in medical schools.

**Keywords.** Biomedical and health Informatics, Education, Scientific Society, Personalized Health, Digital Health

## 1. Introduction

The Italian Society of Biomedical Informatics (Società Italiana di Informatica Biomedica, SIBIM) [1] is a scientific and cultural association founded in 2016, and member of the European Federation of Medical Informatics (EFMI) [2]. SIBIM mission is to link the heterogeneous and complementary expertise existing in the Italian academic and clinical institutions regarding eHealth and digital health. SIBIM members have expertise in a wide range of research topics, including healthcare data integration and standards, clinical informatics, data management, artificial intelligence, patient-centered care and telemedicine, decision support systems, process mining in healthcare, bioinformatics, and regulatory issues regarding software as medical devices, security and privacy. Most of these multiple experiences are the basis of a correct process of personalizing medical care. The SIBIM scientific mission to link academic and clinical institutions with

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<sup>1</sup> Corresponding Author.

industrial partners to develop advanced research projects is complemented by the efforts provided to support eHealth and digital health high-level education (academic courses, PhD, masters, etc.).

While some years ago the efforts of medical informatics education were mostly devoted to creating and preparing a workforce of developers, mainly computer scientists and biomedical engineers, able to implement effective eHealth solutions, the fast evolution of the technology democracy and the emerging definition of 5P eHealth ecosystems [4] highlighted the increased need of improving eHealth literacy of healthcare professionals as end users. This is even more challenging considering the complexity of the eHealth field, in which complexity uncertainty and personalization have a long-standing trade-off with safety, privacy, and confidentiality [10-14].

The geographic coverage of SIBIM members spans all over Italy with representatives from the major Universities of the Country. SIBIM members largely contribute to education in both Medical and Technical Schools, with experience in building degree in medicine including bioengineering programs, such as the ones reported in [3].

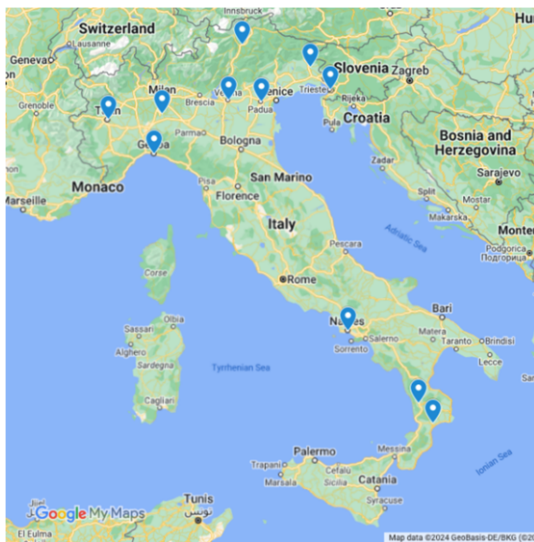
This paper illustrates the results of a survey conducted among SIBIM members in June 2023, and focused on the eHealth education for the digital healthcare workforce, including both medical and technical curricula.

## **2. The Survey**

The questions in the survey were related to the availability of health informatics courses within the Institutions of SIBIM members, and to the programs where such courses are offered. As mentioned, we were interested not only into technical degrees (such as biomedical engineering or computer science), but also into health-related education programs (e.g., medical school, nursing school, etc.). We then asked specific questions aimed at having additional details on the courses, such as the number of lecture hours, the number of students, and the general objective of the course (data analysis, use of software or biomedical devices, application of ICT solutions to clinical settings, fundamentals of computer science applied to biomedical disciplines, data bases and health data management). We also had a free text section where it was possible to specify the topics covered in the course and, finally, we asked the members to give a rate between 1 and 5 to the relevance of the course within the program it belongs to.

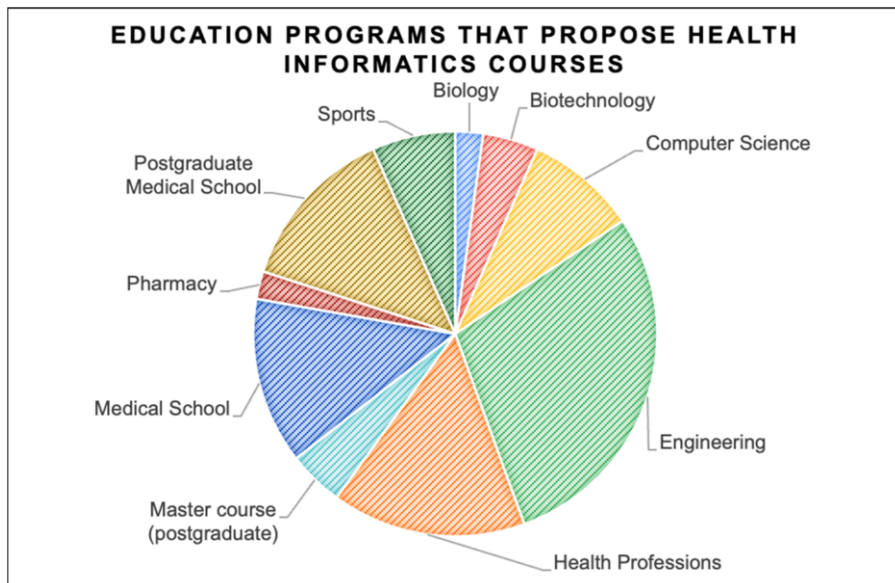
## **3. Results**

Members belonging to 12 different institutions (out of the 17 participating to the Society) in 10 sites answered to the survey, covering a wide range of the Italian eHealth education offer (Figure 1). Interdisciplinary experiences have been reported, showing contribution both in undergraduate as well as graduate students.



**Figure 1.** Geographical distribution of the survey respondents (created using Google Maps).

Figure 2 shows the overall distribution of the education programs that offer courses related to health informatics as a result of the survey. The chart shows that the courses are almost equally distributed among technical programs (Engineering, Computer Science, and technical postgraduate courses) and healthcare-related programs (Medical School, Health Professions including nursing school, postgraduate medical school).



**Figure 2.** Education programs that offer health informatics courses.

The SIBIM members participating in the survey are involved in Medical School courses, including both Medicine and Health professions such as Nursing. In Medical Schools, most courses are dealing with fundamentals of informatics and general aspects

in eHealth such as EHR principles and hospital information systems. In addition, some advanced content is provided, such as an introduction to standards (with focus on HL7[5] and DICOM [6]), data analysis and basics of AI, and applications of data mining to clinical studies.

Ten out of the twelve responding sites have an active Biomedical/Clinical Engineering or Biomedical Computer Sciences degree with a track on eHealth. Several courses included in these tracks specifically address technologies supporting the process of personalizing medical treatment. Figure 3 shows a detailed view of the data we collected regarding the courses delivered in the bioengineering programs. Such courses are delivered both for undergraduate and for graduate students. Undergraduate courses usually deal with the fundamentals of medical informatics (standards, semantic interoperability, EHR, hospital information systems, telemedicine, software as medical device, UML modeling), as well as an introduction to the organization and processes included in the Italian national healthcare system. All the undergraduate programs also include courses related to databases and information systems, a basic course on image and signals analysis, and programming courses (Java, Python, C, Matlab). Graduate courses include advanced topics such as machine learning and artificial intelligence, ontologies, clinical guidelines, bioinformatics, telemedicine, advanced biomedical signal processing, and process modeling.



**Figure 3.** Most frequent topics in biomedical engineering programs (Created with WordClouds.com <https://www.wordclouds.com/>).

Multidisciplinary Ph.D. programs are available at several institution members of SIBIM and offer students the opportunity to study subjects such as biomedical data management and analysis, and to apply techniques in digital medicine. As the national level, in 2021, the National PhD in Artificial Intelligence was started, and “Health and life sciences” has been identified as one of the five strategic areas of specialization. The National Ph.D. course AI Health and Life Sciences [7] is led by Campus Bio-Medico University in Rome and it involves twenty organizations, including universities and research institutions across the country. It is focused on the application of AI in the field of health and life sciences with particular attention to the integration of AI, IoT and biorobotics. This is aimed at enriching the possibilities of forming new profiles able to work not only in medical schools or in research institutions, but also in industries, where the capacity of managing multidisciplinary topics in a large competitive market is crucial.

## 4. Conclusion

The eHealth curricula offered by technical schools are becoming attractive for companies, where positions related to the medical informatics field are becoming more frequent. On the other hand, the eHealth education in medical curricula is often limited only to basic informatics skills, thus suggesting that national eHealth organizations should focus their efforts towards increasing the level of eHealth contents in medical schools (both Medicine and Medical professions). This consideration is coherent with the result of [8], where 451 responses from medical students of 39 European countries show a lack of eHealth contents in medical education. This result was also confirmed at a national level by the survey performed by the board of SIBIM and presented in this paper. The need for advancing eHealth literacy in medical and clinical staff has become fundamental in the light of the National Recovery and Resilience Plan (PNRR), which allocates huge resources (i.e. C 15.6 billion) for the digitalization of medical management in Italy [9]: large numbers of adequately trained technicians will be needed to develop innovative systems, but without a group of adequately trained health professionals these systems are at risk for remaining underused.

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