Article Focus July 2020:

Tuscany at the forefront of digital health research, a fundamental area for facing future social challenges.

Abstract:
Digital health, defined as the application of information and telecommunication technologies within the health sector, plays a strategic role in addressing social and economic challenges: from current or future pandemics, to an ageing population or to increased life expectancy.
Given the need to act quickly to respond to the needs of the population - think of the importance of a timely response during the spread of Covid-19 - and, more generally, to improve the health system as a whole, digital health it is experiencing a period of rapid transformation. In this rapidly changing context, research and scientific skills play a decisive role in being able to anticipate the solutions of tomorrow. In order to identify the main players in Tuscan research, encourage their collaboration and create a system perspective, the use of ToscanaOpenResearch has allowed us to characterise some of the determinants of research in Tuscany relating to digital health and tele-medicine and to identify the main players.
We tell you what emerged from our analysis.

In-depth analysis

Technologies related to digital health and in particular to tele-medicine (i.e. the use of virtual technologies to carry out remote medical diagnoses and therapies) have assumed an **even more important role during the Covid-19 pandemic** and may help limit the spread of viruses, making remote diagnoses and facilitating the exchange of information and reports between different hospitals and departments.

Digital health is a frontier research area, at the intersection of research in Medicine, in Computer Sciences and in Engineering, which provides solutions to address social and economic challenges, such as inequality of access to health, the cost of healthcare health, population ageing and the increase in chronically ill patients (about 40% of Italians), with the aim of promoting the economic sustainability of the national health service in the long term.

Italy has recently seen an **increase in spending on digital health** (up 7% in 2018 according to the 2018-2019 report of the Digital Innovation in Health Observatory of the Politecnico di Milano, reaching a value of **1.39 billion Euro**), but the per capita investment in Italy (about 22 Euro per citizen) remains significantly lower than countries such as Denmark (70 Euro per capita), Great Britain (60 Euro) and France (40 Euro).

The need to rapidly enhance research and technologies related to digital health during this emergency period has resulted in the publication of various tenders to support **research in areas related to the Covid-19 emergency**, including digital health. For example, a tender from the European Union Framework Program Horizon 2020, in support of research and innovation, published to support research useful to counter the effects of the pandemic, has made available almost 60 million Euro of funds for projects related to digital health, out of a total of 120 million Euro of funds. Also, Italy and the Tuscany Region have published, respectively in March 2020 and June 2020, tenders to identify digital solutions that help fight the spread of Covid-19.

In this emergency perspective, it becomes essential to be able to obtain information on those who have contributed and can actively participate in the scientific research necessary to face certain challenges. But how can research skills be identified and characterised on extremely specific and often interdisciplinary topics (such as digital health and tele-medicine), or which can contribute to tackling emerging problems (such as the Covid19 pandemic)?

The Tuscany Region has built an information tool suitable for this purpose, namely ToscanaOpenResearch, which integrates and links numerous open *datasets* on research and higher education, both national and international, whose analysis allows to characterize the regional research innovation and to provide targeted information for decision making.

The use of ToscanaOpenResearch and automatic text processing techniques (the content of scientific publications, research projects and other textual documents such as patents is analysed to know which research is carried out) has allowed to **characterise the research carried out in Tuscany relating to health digital and tele-medicine over**

a period of 10 years, and to compare the results with the national context.

All scientific publications and European funded research and innovation projects in which at least one Tuscan player took part, in the period 2008-2018, were analysed.

The *abstracts* of the documents were processed with *machine learning* techniques to identify those relating to the areas of interest, through the identification of keywords.

In Tuscany, **1097 scientific publications** were made in the field of digital health, during the period 2008-2018, corresponding to approximately **13% of national production on the same topic**.

The main players active in this area are presented in the table below, which shows the **top eight organisations by number of publications in the digital health sector in the period 2008-2018 in Tuscany**. The percentage of publications produced by the institution with respect to the total of Tuscan publications and the most recurring topics is indicated. The topics corresponding to cells with coloured background in the table are those that have been dealt with in the publications. Each publication can be linked to several institutions and therefore the total is more than 100%.

Public research players make the main contribution to digital health, with the presence of a great variety of institutions: ranging from 3 generalist universities, to specialised institutions such as the Sant'Anna School, to Hospitals and public research institutes.

In addition to the institutional players, the ToscanaOpenResearch system also makes it possible to identify individual researchers and *principal investigators* (PI) active in this field.

Name of the organisation	City	% publications	digital health	tele-medicine	mobile health	biomedical robotics	domotics	aged & frail
University of Florence	Florence	24%	■	■	■			■
Pisa University	Pisa	23%	■	■	■	■		■
Sant'Anna High School of University Studies and Specialisation School	Pisa	14%	■	■	■	■		■
Careggi Hospital	Florence	13%	■	■	■	■		■
Siena University	Siena	8%	■	■	■	■	■	■
Pisa University Hospital	Pisa	7%	■	■				■
CNR Institute of Clinical Physiology	Pisa	5%	■	■		■	■	■
Meyer Children's Hospital	Florence	3%	■	■				

Percentage of publications for Tuscan institutions and topics covered (2008-2018)

Thanks to the use of semantic techniques, it is possible to identify the **keywords that emerge by analysing the digital health publications in Tuscany**. The significant presence of words such as "aged, 80 and over" and "ageing" can be linked to one of the typical "use cases" for digital health, namely the remote monitoring of the elderly, a more fragile category, often subject to reduced mobility.

The analysis of **European funded projects** provides another point of view than the one obtained from publications, providing information on projects that have passed a very competitive process of allocating funds at European level. The Tuscan entities participated in **18 different projects in the field of digital health** in the period 2007-2018, in the context of the FP7 and H2020 framework programs, **corresponding to approximately 20% of national projects on the same theme**. Several of these projects include the collaboration of several Tuscan institutions. Among the main organizations in terms of number of participations, the Sant'Anna High School of University Studies and Specialisation School stands out, which has collaborated in 6 projects, followed by the University of Pisa (5 projects) and the private company Smartex S.r.l. (3 projects).

Name of the organisation	Participation in European projects	Fields
Sant'Anna High School of University Studies and Specialisation School	6	Robotics; tele-medicine
Pisa University	5	digital health; tele-medicine
Smartex S.R.L.	3	Robotics; digital health; tele-medicine

Top 3 Tuscan players for participation in European funded research and innovation projects in the "Digital Health"

We can conclude that **research in Tuscany is particularly active in the field of digital health and tele-medicine compared to the national average** and that this pool of skills represents a resource of great potential for facing current and future challenges, such as those related to the ageing of population and the specific needs of the most fragile categories.