Access to Medical Imaging Equipment in the Piedmont Region : A Proof of Concept

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ABSTRACT
To strengthen management capability of Medical Imaging Equipment (MIE) in the Piedmont region, an approach is proposed which considers MIE distribution across regional sub areas together with their actual use (including utilisation rate, travel distance and waiting times). A number of regional information sources are used consisting of the health technology platform FITeB, the Health Registry and geo-spatial data. First, an overview of the spatial coverage of MIE in the regional local areas (provinces) is presented. Then, patient flows using MIE are examined and travel/time distance to access MIE discussed. The analysis makes reference to a period of time (2013-2017) in which, in order to improve the sustainability of the regional health system, a re-organisation of heath service delivery took place. Results of this study provide some evidence of the change which occurred in the access to MIE medical examinations.

KEYWORDS
Medical Imaging Equipment, Health regional registry, Health journeys, Accessibility, Health technology management and assessment

RÉSUMÉ
Pour mieux gérer les équipements d'imagerie médicale (*medical imaging equipment*, MIE) dans la région du Piémont, cette étude propose une approche qui prend en compte la distribution des MIE dans les provinces ainsi que leur utilisation (y compris le taux d'utilisation, la distance de déplacement et le temps d'attente). Différentes sources de données régionales sont utilisées, la plateforme des technologies médicales (FITeB), le registre des soins de santé et des données géo-spatiales. D'abord, on donne un aperçu de la couverture spatiale des MIE dans les provinces du Piémont. Ensuite, on examine les flux de patients utilisant les MIE et les distances de voyage /temps pour accéder aux services qui les offrent. L'analyse fait référence à une période, les années 2013-2017, pendant laquelle les services régionaux ont été réorganisés. Quelques aspects des changements dans l'accès aux MIE qui se sont produits suite à cette réorganisation sont discutés.

MOTS CLÉS
équipement pour l'imagerie médicale, archive des données des soins de santé, déplacements pour les soins de santé, accessibilité, gestion des technologies médicales, évaluation des technologies de la santé

1. BACKGROUND

Medical Imaging Equipment (MIE), such as MRI (Magnetic Resonance Imaging), PET (Positron Emission Tomography) and CT (Computer Tomography) have a critical role for improving healthcare and prevention.
As these technologies become more widespread, evidence is mounting that an appropriate use of MIE allows physicians to better diagnose and treat patients, and ultimately produce significant gains in the health status and the quality of life of patients, workforce productivity and cost efficiency.
The expected benefits, however, are difficult to gauge and balance out against the need to contain rising healthcare costs. Recommendations exist that spur healthcare organisations to consider the total value that can be derived from their investment in the long term and how advanced technology can help contain costs (Abbam, 2014).
To make healthcare organisations more sustainable, a whole system approach is advocated which helps judge what they are willing to pay and give up for health innovation. As for Health Technology Assessment (HTA), in particular, current approaches should become more agile, re-articulating scientific dialogue and stakeholder engagement and re-thinking value, affordability and access (Husereau *et al.*, 2016).

Although the arguments are central to the health innovation literature, few studies (if any) have tackled them at a regional level. This paper contributes to fill the gap and the case of Piedmont is presented. It draws attention to the fact that capacity of managing MIE asset at a regional level should be strengthened. Here capacity is loosely understood as the ability of healthcare organisations to appraise the impact of technological solutions on healthcare provisions and steer their development in the decision area they are responsible for (Aroni, 2012). An important element for building capacity is the availability of appropriate management support systems for information sharing and monitoring (WHO, 2007).

In Piedmont, an information flow for biomedical technologies, named FITeB, has been created by the regional Health Authority in 2012. It yearly gathers a set of data about large medical equipment, including MIE, innovative equipment and medical devices.

Integrating information about MIE's distribution across health organisations and their actual use (including utilisation rate, travel distance and waiting times) would be a valuable addition in regional HTA procedures and decision-making about health technological investments and dis-investments.

Insights of the integration effort are discussed in the paper.

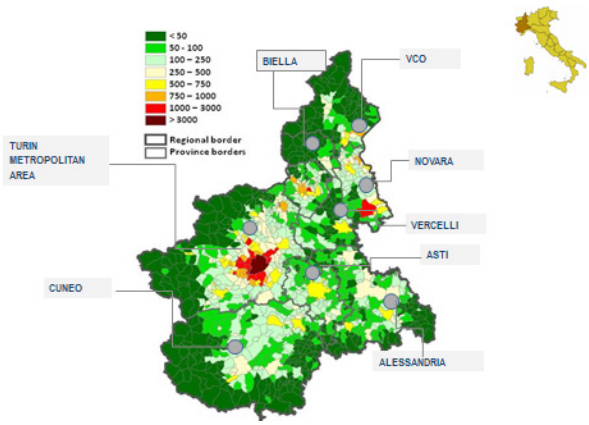
To facilitate the comparison of Piedmont with other regional areas, the analysis is primarily conducted at province level and considers two points in time, 2013 and 2017. In this time span, a re-organisation of heath service delivery took place in Piedmont with the purpose of raising healthcare quality level and handling financial constraints. Results of this study make it possible to investigate the impact of this re-organisation also on the population accessing MIE medical examinations.

2. SPATIAL DISTRIBUTION AND COVERAGE OF THE MEDICAL IMAGING EQUIPMENT (MIE)

Situated in the Northwest of the country, Piedmont has a population of 4.3 million inhabitants, most of which (80%) live in a few large cities and their surroundings areas (fig 1). It is an area where the needs and expectations of an aging population living longer are fuelling a growing demand for care-serving, including health technology solutions.

Medical examinations through MIE are delivered in public and private specialty care premises, hospitals and emergency departments. Overall, 94 health facilities, including public affiliated ones, provide MIE service; they are located in 50 municipalities, most of which are in the Turin metropolitan (province) area. Turin, the regional chief town, concentrates nearly one out of four of these health facilities, but more than 20% of the resident population lives there.

Figure 1. Province districts and population density (inhabitants per km²) in the municipalities
Source: ARPA Piemonte



Not unexpectedly, because of the regional urban pattern, the distribution of MIE varies significantly across the provinces (fig. 2).

In 2017, about 60% of MIE belongs to public health organisations, but the share is much higher in certain provinces (Cuneo and VCO). The Turin province has the greatest number of MIE but its ratio to population (MIE density) is lower than in other areas.

Reference values for optimal MIE diffusion do not exist. OECD (2019) states that "there is no general guideline or international benchmark regarding the ideal number of CT scanners or MRI units per million population. However, too few units may lead to access problems in terms of geographic proximity or waiting times. If there are too many, this may result in overuse of these costly diagnostic procedures, with little if any benefits for patients".

In Piedmont, MRI and CT are the most widespread MIE (Bellelli & Turchetti, 2018). In 2017, the regional value of MRI density (21 per million inhabitants) ranked below the Italian average (29), but it was higher than that for the OECD countries (17). CT density in Piedmont (21) was lower than the Italian average (35) and below that for the OECD countries (27).

In addition to the difficulties to evaluate MIE diffusion rate, the age of MIE is a major concern. Approximately, one-third of the MRI and CT in 2017 are more than ten year old and do not meet the golden rule for medical equipment refurbishing, according to which only 10% of the equipment should be as old as 10 years.

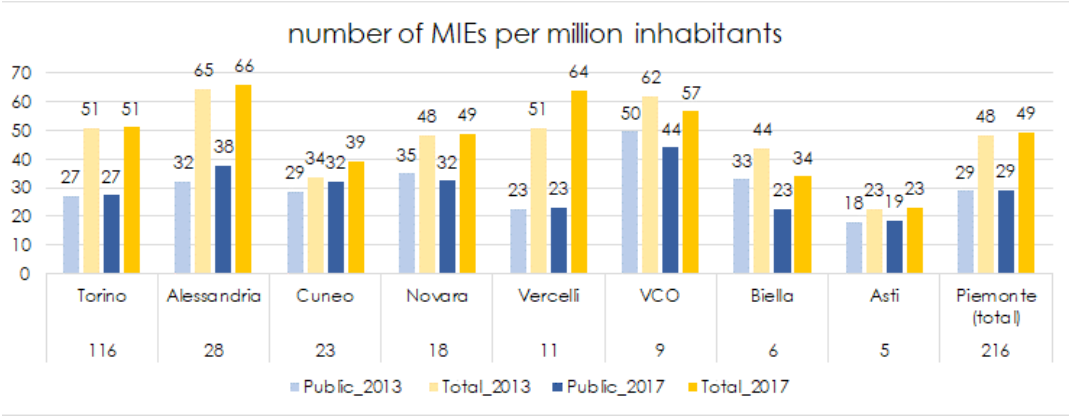


Figure 2. MIE density in healthcare public settings in the provinces and Piedmont, 2013, 2017[1]
Source: FITeB and ISTAT

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3. ACCESSING MIE: JOURNEYS TO SERVICES, UTILISATION RATE, TRAVEL TIME AND DISTANCE

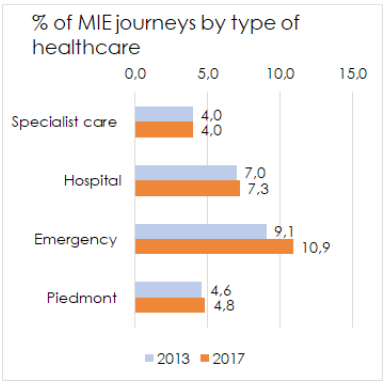
3.1. A Regional Overview

Building upon previous research (Occelli & Dalmasso, 2019), we analyse the journeys undertaken by the resident population in 2013 and 2017 to reach the facilities providing MIE examinations. The main information source is the Regional Health Information System which records every access to the specialist level of assistance, together with population and clinical data.

The number of journeys can be regarded as a measure of revealed accessibility (Gatrell & Wood, 2012; Souliotisa *et al.*, 2106) and in this context represent the actual use of health services. When considered from the origin point of view, insights are given about population's health needs. The destination point of view, likewise, offers evidence of the delivering capacity of healthcare organisations.

Table 1. Total and MIE journeys by main type of healthcare in Piedmont, in 2017 and variation from 2013[2]
Source: Piedmont Health Registry

		N. journeys	percentage	var 2017/13
Total	Specialist care	14463226	85,5	0,94
	Hospital	791078	4,7	0,87
	Emergency	1659212	9,8	0,98
	Piedmont	16913516	100,0	0,94
MIEs	Specialist care	581923	71,0	0,94
	Hospital	57380	7,0	0,91
	Emergency	180736	22,0	1,18
	Piedmont	820039	100,0	0,98



1 The total number of MIE equipment in 2017 is shown below the province name.

2 Only the journeys by the resident population to health premises located in Piedmont are considered. This means that patient flows to and from other regions are excluded from the analysis.

MIE journeys represent a small share of the regional health mobility (around 5%). Three out of four MIE journeys are undertaken for specialist care diagnosis. In spite of a 6% decline in their absolute number since 2013, in 2017 their share slightly increased (tabl. 1).

Not unexpectedly, MIE utilisation is highest for people treated in emergency care. In 2017, 11% of them were treated with this kind of health technology, and their number increased by about 18% since 2013.

Between 2013 and 2017, MIE utilisation rate (number of journeys per inhabitants) diminished slightly, but variability across the province districts reduced as well (fig. 3). The number of inter-municipality journeys grew in the period and average travel times increased in all the districts with the exception of Turin and Biella areas.

3.2. ACCESS TO MIE SERVICES FOR SPECIALIST CARE

Figure 4 shows the average travel distances for MIE specialist care journeys in the provinces, from the twofold points of view of origin and destination. When assessing the situation of an area, differences between origin and destination travel distances provide clues of the delivery capability of MIE services in the area. The smaller these differences are, as in Turin, Alessandria and Novara provinces, the better the situation is. Both origin and destination travel distances increased between 2013 and 2017: the former grew more than the latter in all the provinces except in Turin and Alessandria.

Figure 3. 2013-2017 variation of MIE utilisation rate and average travel time (for inter-municipal journeys only) in Piedmont provinces[3]

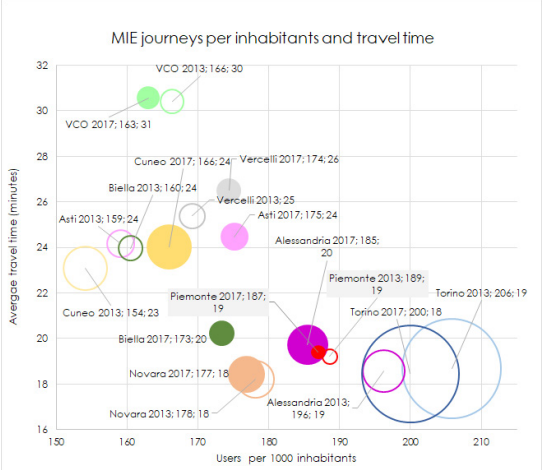
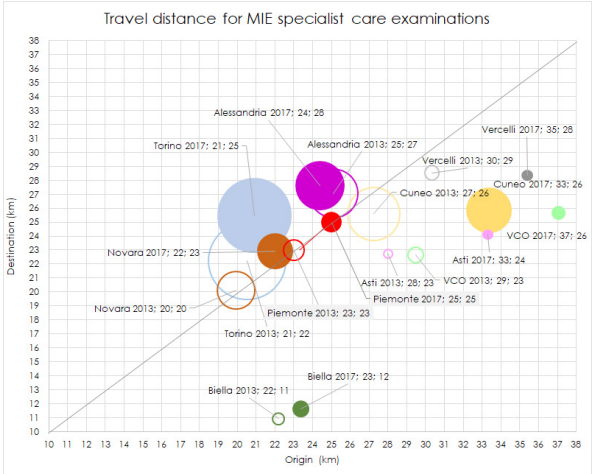


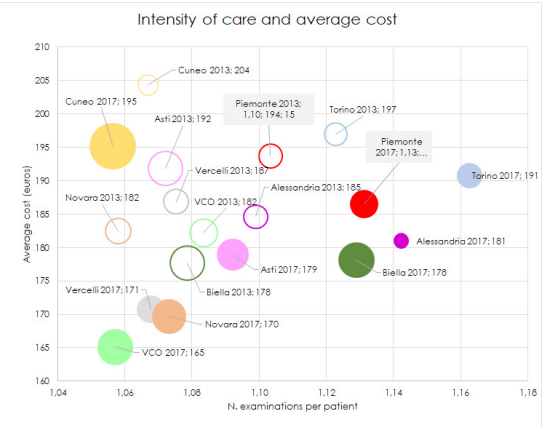
Figure 4. Travel distances for MIE inter-municipality journeys for specialist care, in Piedmont provinces, in 2013 and 2017[4]



Source: Piedmont Health Registry and Transportation Department

An interested finding is that the reduction in the physical access to MIE services has been accompanied by an improvement in other factors of access: the number of examinations per patients grew slightly in all provinces (except in Cuneo) and the average patient cost also declined. A negative result, which however will need further investigation, is that waiting times have become longer.

Figure 4. Number of MIE examinations and average costs per patients, for MIE examinations in Piedmont provinces in 2013 and 2017[5]
Source: Piedmont Health Registry



CONCLUDING REMARKS

Evidence from this study shows that the re-organisation in health-care delivery which occurred in Piedmont in the 2013-2017 also affected the population having MIE medical examinations.

Although at an early development stage, the potential of the approach can be appreciated from two points of view.

First, for the Piedmont case, it demonstrated how different data pipeline, related to MIE technology, population and physical access, could be connected. The richer evidence resulting from this effort could be valuable in current MIE assessment procedures. Even more notably, it would help establish a collective intelligence

3 The bubble size is proportional to the flows, except for Piedmont.

4 Piedmont origin and destination travel distances are identical. The bubble size is proportional to the number of journeys, except for Piedmont.

5 The bubble size is proportional to the waiting times.

about the impact of these technological solutions across the Piedmont healthcare organisations (Ainsworth & Buchan, 2015).

Second, on the research ground, the approach might pave the way to the development of a common framework for analysing MIE diffusion, access and take-up across European regions. The effort would permit to address access barriers in practice, facilitate exchange of knowledge and expertise, and ultimately improve access to healthcare between and within European regions (Souliotisa *et al.*, 2016).

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