



RESEARCH

Open Access



# Private hospitals in low- and middle-income countries: a typology using the cluster method, the case of Morocco

Saad Zbiri<sup>1,2,3,4\*</sup> , Abdelali Belghiti Alaoui<sup>1,3</sup>, Imad El Badisy<sup>1,2,5</sup>, Najib Diouri<sup>6</sup>, Sanaa Belabbes<sup>1,2,3</sup>, Radouane Belouali<sup>1,2,3</sup> and Zakaria Belrhiti<sup>1,2,3</sup> 

## Abstract

**Background** The private healthcare sector has become an essential component of healthcare systems globally. This interest has increased with the universal health coverage agenda. However, in most low- and middle-income countries, few classificatory studies of the private hospital sector were carried out.

**Methods** This study describes the private hospital sector in a developing country setup and propose a typology that could facilitate the identification of its categories and the understanding of its organizational and strategic characteristics.

**Results** All private hospitals in Morocco as of December 31, 2021 including 397 facilities are included. Most hospitals are for-profit, poly-disciplinary, independent, commercial societies, have fewer than 30 beds or between 30 and 99 beds and are located in urban areas. Private hospitals have a median turnover of 9.8 million MAD and a median capital value of 2 million MAD. The clustering method identifies three main categories of private hospitals: for-profit hospitals with medium size and turnover, spread across the country but with a high concentration in large regions; not-for-profit hospitals, with medium to large size, high turnover, located in large regions and including university hospitals; and small for-profit hospitals with low turnover, independent ownership and wide distribution over the country. Three criteria have the most significant discriminatory power: ownership, size (beds, turnover) and mode of governance.

**Conclusions** Private hospitals in Morocco are organized into three types according to three similarity criteria including ownership, size and governance. These criteria might be used as the basis for a common typology of private hospitals in Morocco and possibly in other low- and middle-income countries with similar contexts.

**Keywords** Hospitals, Private sector, Characteristics, Typology, Profile, Morocco

\*Correspondence:

Saad Zbiri

saad.zbiri@ia2s.org

<sup>1</sup>Mohammed VI International School of Public Health, Mohammed VI University of Sciences and Health (UM6SS), Boulevard Mohammed Taieb Naciri, Commune Hay Hassani, 82 403 Casablanca, Morocco

<sup>2</sup>Laboratory of Public Health, Health Economics and Health Management, Mohammed VI Center for Research and Innovation (CM6RI), Rabat, Morocco

<sup>3</sup>Knowledge for Health Policies Center, Casablanca, Morocco

<sup>4</sup>Institut d'Analyse des Systèmes de Santé (IA2S), Paris, France

<sup>5</sup>Platform for bioinformatics and data analysis, Mohammed VI Center for Research and Innovation (CM6RI), Rabat, Morocco

<sup>6</sup>Alium Santé Maroc, Casablanca, Morocco



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

## Background

Academic interest in the private healthcare sector dates back to the 1960s with the emergence of private for-profit hospital companies in the United States heralding the birth of the hospital industry. This birth occurred during a period of rapid growth in health expenditure and allowed the creation of a new competitive environment allowing hospitals to develop independently from health policies [1]. To segment this new market, a first categorization of hospitals was imposed through the identification of three types of establishments in the private hospital sector depending on the ownership of the hospitals: not-for-profit hospitals, independent hospitals and investor-owned hospitals. This development also enabled hospital activity to establish itself as an industrial category in the United Nations' international classification of economic activities (ISIC rev.3) from 1989 and subsequently in other industrial classifications.

In developing countries, the dynamics of healthcare demand and supply have led to a growing need for private healthcare facilities. The area where private sector involvement held the greatest potential was in hospital care [2]. More recently, healthcare reforms in various countries have sought to increase the role of the private healthcare sector to complete public sector activities. The general argument was that these reforms could maintain equity in healthcare financing while promoting efficiency by introducing and encouraging competition. Today, the private sector is increasingly serving as a partner to public health systems, particularly in the provision of clinical care [3].

Yet, mixed evidence still exists on the relationship between hospital ownership (private not-for-profit, for-profit and public) and the variable effects on hospital performance and quality of care, as well as on out-of-pocket payments. These variations are largely explained by differences in institutional context, including differences between markets, regions, data sources and over time [4–6].

An increasing interest has been paid by international organizations in redefining the role of the private sector in health reforms [1] and in progressing towards achieving public health objectives [7]. In the same line, the WHO proposed a definition and an initial global typology of the private healthcare sector in 2005 [7]. Recently, this growing interest increased with the advent of universal health coverage (UHC) which led to considering the private sector as lever for health systems strengthening in all low and middle-income countries (LMICs) [8, 9].

Currently, the private sector provides almost 40% of all health care in the Latin American, African and Western Pacific regions, 57% in the South-East Asian region and 62% in the Eastern Mediterranean region. Weighted regional results indicate that 53% of hospital care is provided in the private for-profit sector [10]. In OECD

countries, private hospitals, both for-profit and not-for-profit, have gained significant shares of the healthcare market. They now represent 77% of hospitals in the United States, 75% in Germany, 56% in Spain, 55% in France and 48% in Australia [11].

However, there are very few descriptions of the profile of private hospitals in LMICs. In the Philippines, Lavado et al. were able to cover nearly all aspects of hospital organization. But their study only focused on four regions [12]. To our knowledge, this is the only study identified in LMICs and that covers so many variables. This can be explained by the fact that in the Philippines the private hospital sector is highly developed. In addition, very few studies have been carried out using clustering methods applied to private hospitals in LMICs. Most of these studies do not use national databases and do not offer a typology [13]. Some studies have used hospital clustering methods based on the characteristics of health professionals and not on the characteristics of hospitals [14]. Others studies have attempted a typology focusing on the entire private sector and not just on private hospitals [15].

Thus, through its evolution, the private hospital sector become an important component of the healthcare system and of the reform dynamics. Despite this importance, the classification and typology of private hospitals have received little attention from policy makers and researchers. This study argues that it is not possible to adequately approach the analysis and development of the private sector without an empirical understanding of its overall organization and characteristics. In this context, and in order to advance the understanding and documentation of the private hospital sector, we propose the development of a typology to better describe and understand the private hospital market. This typology could thus facilitate the identification of categories of private hospitals sharing common organizational and strategic characteristics, which could be used to analyse the dynamics of change in this sector. The relevance of this typology is tested through its application for the documentation of the private hospital sector in Morocco.

## Methods

### Study context

The Moroccan health system is organized into several interconnected healthcare networks, combining a dense public healthcare network in 12 decentralized health regions, and an expanding private healthcare sector, located mainly in major urban areas, particularly on the Casablanca-Rabat axis. In 2021, the public sector comprises 2985 primary healthcare centers providing supportive, preventive and curative care [16]. Secondary and tertiary care are provided by a pyramid-shaped public hospital network including 165 local, regional and

inter-regional hospitals (as well as 157 support facilities) accounting for a total of 26 771 beds and 13 682 medical practitioners. The public sector has a ratio of 1375 inhabitants per hospital bed. The private sector has over 12 534 beds and 14 199 medical practitioners [17]. Most private physicians are self-employed but some physicians are public-sector employees and are practicing in private hospitals (part-time practice or dual practice). The capital of private hospitals is funded by independent actors (mostly physicians) (86%), national and international financial holdings (8%), health insurance organizations (3,3%) and non-profit foundations (2,6%) [18].

### Delimitation of the study object

The overall definition of what constitutes a “hospital” is similar in all countries, with specific characteristics inherent to each country’s history. The word “hospital” currently covers a wide range of institutions, from small rural facilities to large university clinics, from small community centers to giant complexes with multiple head offices and large numbers of employees [19]. In the United Nations classification of all economic activities (ISIC rev.4), hospitals are understood as “*human health institutions which have accommodation facilities and which engage in providing diagnostic and medical treatment to inpatients with any of a wide variety of medical conditions*” [20]. In the OECD classification of systems of health accounts, hospitals are defined as “*licensed establishments that are primarily engaged in providing medical, diagnostic and treatment services that include physician, nursing and other health services, to inpatients and the specialized accommodation services required by inpatients*” [21]. In some countries, health facilities must additionally have a minimum size, such as a number of beds and medical staff to ensure 24-hour access, in order to be registered as a hospital. Currently, the private hospital sector comes in many shapes and sizes, ranging from small physician-owned facilities to large, publicly traded, for-profit hospital chains [22].

In a similar vein, private hospitals are, according to the global health observatory of the WHO, “*hospitals not owned by government or to parastatal organizations*”. They include both private not-for-profit hospitals and private for-profit hospitals [10]. Thus, a private hospital is a non-state-owned health facility authorized to provide specialized inpatient and/or outpatient healthcare. It is sometimes called a private clinic (Morocco, Tunisia) or a private health establishment (France). In this work, these names will be used interchangeably.

### Framework development

The rationale behind developing a typology of healthcare facilities is to allow for continuous refinement of actors, understanding and analysis of the healthcare system and

systematic organizational analysis. It also facilitates comparison by referring to the same categorization criteria, and can be used as a regulatory framework. Typologies are thus a useful and widely used tool in understanding and describing health organizations. Thereby, the use of typologies makes it possible to reduce the complexity of “messy” empirical realities, allowing it to systematically analyse similarities and variations and to detect and interpret patterns [23].

To develop a framework to categorize private hospitals, we adopted an empirically-driven approach rather than a theoretically-driven approach. The empirical approach is not based on a theoretical pre-selection of relevant indicators to deduce ideal types but rather on empirical data [24]. We built our framework primarily on international classifications governing the hospital market as a health industry (United Nations, OECD, WHO, Research and Markets) (see Additional file 1 for more details), discussed and supplemented by empirical policy documents based on country experiences (Morocco, Tunisia, France, United States) (see Additional file 2 for more details). Therefore, the resulting typology corresponds to a real categorization (clusters) and not to a theoretical modeling. We adopted a single two-step approach, in which the cluster analysis followed the descriptive analysis and literature review. The steps of the typology building process are described in Fig. 1.

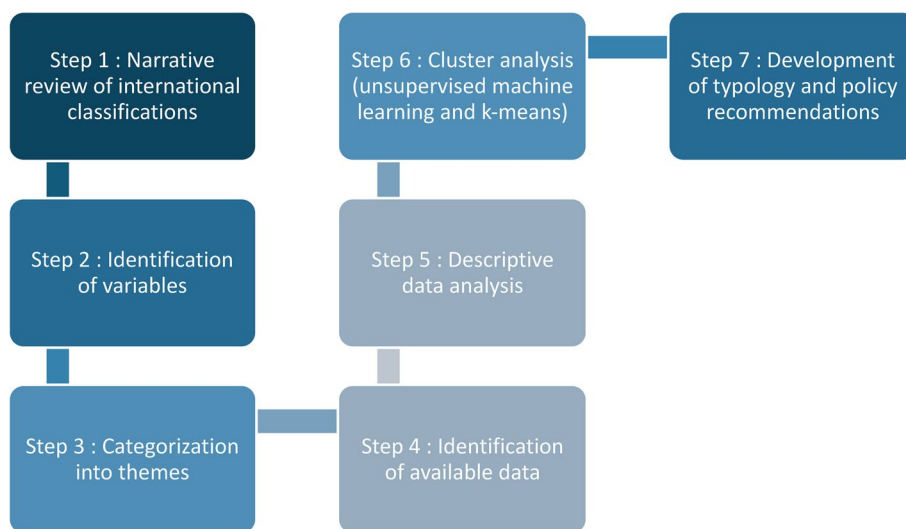
In this context, our narrative review of international classifications enabled us to identify nine criteria with 15 variables for the categorization of private hospitals (Table 1).

### Collection of data

We collected data in Morocco during the year 2021 using two main databases:

- The database of the Ministry of Health relating to the supply of care [25].
- The private database of *Inforisk SA*. specialized in legal and financial information on companies. It is the richest and most up-to-date database on Moroccan companies. Its platform *Charika.ma* provides access to legal and financial information on more than 760 000 Moroccan companies and more than 500 million companies in 230 countries around the world.

These two databases have been cross-referenced, cleaned up and completed by collecting updated information through direct contact with private hospital key stakeholders. These collected data were the subject of a two-stage analysis. First, a descriptive statistical analysis to define the profiles of private hospitals in Morocco was based on seven criteria and ten variables, as shown in Table 1, including hospital ownership, specialisation,



**Fig. 1** Flow diagram of the typology building process

**Table 1** Categorization of criteria for private hospitals identified in the literature review

Criteria	Variables	Considered in this study
<b>Physical location</b>	1. Urban or rural	Yes
<b>Territorial distribution</b>	2. National, regional or provincial (district)	Yes
<b>Membership</b>	3. National or multinational	No
<b>Ownership</b>	4. For-profit or not-for-profit	Yes
<b>Legal form (status)</b>	5. <i>If for-profit</i> : professional civil society (SCP), public limited company (SA), limited liability company (SARL), limited liability company with sole partner (SARLAU) or general partnership society (SNC) <i>If not-for-profit</i> : association, NGO or Foundation	Yes
<b>Size</b>	6. Number of beds	Yes
	7. Staff number	No
	8. Number of patients (inpatients and outpatients) or population coverage (geographical patient catchment)	No
	9. Turnover	Yes
	10. Capital	Yes
<b>Governance</b>	11. Independence, corporate group, health network, others (private hospitals under supervision for example)	Yes
<b>Specialisation (services)</b>	12. Poly-disciplinary (number of specialties) or mono-disciplinary	Yes
	13. Teaching status	Yes
<b>Performance</b>	14. Net income	No
	15. Quality (accreditation for example)	No

number of beds, type of governance, declared turnover, capital, legal form, university status, population covered and region. Second, a cluster analysis was performed to identify a private hospital typology.

**Cluster analysis**

Factor, cluster and discriminant analyses are used to analyse data collected from private hospitals for the year 2021. Private hospital data were analysed using an unsupervised clustering approach, where nine variables with seven criteria were used to construct the clusters. These variables cover the main characteristics of private hospitals. The other two criteria including membership and

performance, as well as six variables were not analysed, as the corresponding information is not available in the majority of private hospitals.

The method used to construct the clusters is a mixed method based on the combination of the k-means algorithm [26] and Gower’s distance measure [27, 28].

In practice, a dissimilarity matrix between observations is first calculated. Then, this matrix is used as input to the k-means algorithm.

The k-means method aims to separate data points with different characteristics into different clusters and group data points with similar characteristics together. It is an iterative algorithm that, regardless of its starting point,

converges to a solution. For each starting point, a different solution can be found. The calculations are repeated

several times to select the best solution for the chosen criterion.

Iteratively, a starting point is chosen for the first iteration, which consists of matching observations with the centroids of the  $k$  clusters. After determining the distance of the observations from the  $k$  centroids, they are assigned to the closest one. The observations are then redistributed according to their distance from the new centroids, and so on, until convergence is achieved.

The optimal number of clusters can be determined using a variety of techniques. In our study, we used the elbow method [29]. It uses sum-of-square to evaluate the goodness of split. Then, an elbow plot of sum-of-square for  $k$  values ranging from two to  $N$  is created. As a rule, when  $k$  increases, the corresponding sum-of-square will decrease. A trade-off between  $k$  (i.e. number of clusters) and sum-of-square can be observed. Typically, the optimal value of  $k$  starts to flatten out and forms an elbow shape.

All the analysis was carried out using the R software [30].

#### Ethical and regulatory considerations

As the study is retrospective, based on anonymized data and purely observational, it was exempt from institutional review board approval according to the Moroccan legislation (law number 28–13) [31].

#### Results

A total of 397 private hospitals are considered in this study and are thus included in the clustering algorithm. They represent all private hospitals in Morocco, called private clinics, as of December 31, 2021. “Establishments assimilated” to private clinics, such as dialysis centers and medical radiology centers, are not taken into consideration in this study because they do not correspond to our definition of a private hospital.

#### Private hospital characteristics

The distribution of the characteristics of the study hospitals are presented in Table 2. Regarding hospital ownership, the majority (93.2%) are for-profit hospitals and 6.8% are not-for-profit hospitals. However, the latter represent 17.3% of the total bed capacity of private hospitals due to the importance of their size. 18.6% of the study hospitals are mono-disciplinary while 81.4% are poly-disciplinary. 50.4% of private hospitals have less than 30 beds and barely 5.8% have 100 beds or more. In terms of geographical distribution, among the 12 regions in Morocco, 5 regions include 79.3% of private hospitals (Casablanca-Settat, Rabat-Sale-Kenitra, Marrakech-Safi, Fes-Meknes and Tanger-Tetouan-Al Hoceima). The Casablanca-Settat region alone includes 30% of private hospitals and 40% of their beds, at a time when two regions have none. Also, the majority of private hospitals are

**Table 2** Characteristics of the private hospitals in Morocco

Variables	All private hospitals (N= 397)
<b>Ownership</b>	
For-profit	370 (93.2%)
Not-for-profit	27 (6.8%)
<b>Specialisation</b>	
Mono-disciplinary	74 (18.6%)
Poly-disciplinary	323 (81.4%)
<b>Number of beds</b>	
< or = 29	200 (50.4%)
30–99	174 (43.8%)
> or = 100	23 (5.8%)
<b>Governance</b>	
Independent	344 (86.6%)
Corporate group	29 (7.3%)
Health network	11 (2.8%)
Under tutelage	13 (3.3%)
<b>Declared turnover(MAD)<sup>a</sup></b>	
Mean (SD <sup>b</sup> )	16 000 (20 700)
Median [Min <sup>c</sup> , Max <sup>d</sup> ]	9 780 [6.5–178 000]
<b>Capital (MAD)<sup>a</sup></b>	
Mean (SD <sup>b</sup> )	8 323 (52 909)
Median [Min <sup>c</sup> , Max <sup>d</sup> ]	2 000 [10–775 135]
<b>Legal form</b>	
Commercial society	366 (92.2%)
Civil society	4 (1%)
NGO <sup>e</sup> or foundation	14 (3.5%)
Other	13 (3.3%)
<b>University status</b>	
Teaching center	4 (1.0%)
Non-teaching center	393 (99.0%)
<b>Population</b>	
Urban	355 (89.4%)
Rural	42 (10.6%)
<b>Region</b>	
Casablanca-Settat	119 (30.0%)
Rabat-Sale-Kenitra	68 (17.1%)
Marrakech-Safi	44 (11.1%)
Fes-Meknes	42 (10.6%)
Tanger-Tetouan-Al Hoceima	40 (10.1%)
Souss-Massa	30 (7.6%)
Beni Mellal-Khenifra	26 (6.5%)
Oriental	23 (5.8%)
Draa-Tafilalet	4 (1.0%)
Guelmim-Oued Noun	1 (0.3%)

<sup>a</sup> In thousands of Moroccan dirhams (MAD)

<sup>b</sup> Standard deviation

<sup>c</sup> Minimum

<sup>d</sup> Maximum

<sup>e</sup> Non-governmental organization

located in urban areas (89.4% versus 10.6%). In terms of governance, the majority (86.6%) are independent hospitals while 7.3%, 2.8% and 3.3% are corporate group, health network and under tutelage private hospitals, respectively. The turnover of the study hospitals ranges from 6.5 thousand to 178 million Moroccan dirhams (MAD), with a median of 9.8 million MAD and a mean of 16 million MAD. Regarding the value of capital, nearly 55% of private hospitals report it among their data. It varies from 10 thousand to 775 million MAD with an average of 8.3 million and a median of 2 million MAD. The range of variation in turnover and capital is too wide between private hospitals. This shows that the declaration of these values is most likely not well regulated. Finally, regarding their legal form, 92.2% of hospitals are commercial societies (SA, SARL, SARLAU or SNC), 1% are civil societies (SCP), 3.5% are non-governmental organizations (NGOs) or foundations and 3.3% have other legal forms.

#### Number of clusters

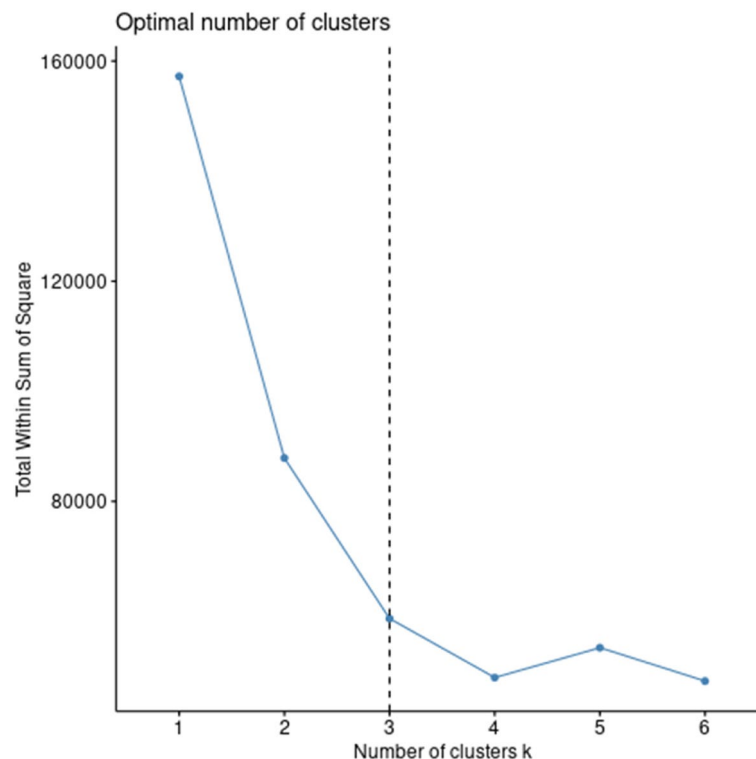
One of the most difficult problems in any applied cluster analysis is determining the number of clusters in which to group the data. Our clustering separation metrics recommend three as the number of clusters that convey most information. This is consistent with the aspect of the elbow plot, which shows that the additional contribution to the variance explained is smaller after three

clusters (Fig. 2). Following the elbow plot and the majority rule, the number of clusters was set to three.

#### Private hospital categories

The hospital profiles identified by the k-means algorithm are presented in Table 3. The hospitals included in each cluster have different patterns.

Cluster 1 consists of 169 private hospitals. All hospitals are for-profit and most of them are poly-disciplinary (91.7%). The number of beds is average with 93.5% hospitals having between 30 and 99 beds, and only 6.5% having 100 beds or more. In terms of governance, hospitals are mainly independent (88.8%) and 11.2% are part of corporate groups. The turnover of the hospitals ranges from 492 thousand to 87.7 million MAD, with a mean of 19.2 million MAD and a median of 14.5 million MAD. The most common legal form is commercial society (99.4%) while only one hospital is a civil society owned hospital. All hospitals are non-teaching centers and the majority of them are located in the urban area (94.7%). Hospitals are located in the region of Casablanca-Settat (37.3%), the region of Rabat-Sale-Kenitra (16%), the region of Fes-Meknes (11.2%), the region of Oriental (9.5%), the region of Marrakech-Safi (8.9%), the region of Tanger-Tetouan-Al Hoceima (6.5%), the region of Souss-Massa (6.5%), the region of Beni Mellal-Khenifra (3%) and the region of Draa-Tafilalet (1.2%).



**Fig. 2** Cluster separation according to the number of groups in the clustering algorithm

**Table 3** Private hospital profiles identified by the clustering algorithm

Variables	Cluster 1 (N = 169)	Cluster 2 (N = 32)	Cluster 3 (N = 196)
<b>Ownership</b>			
For-profit	169 (100%)	5 (15.6%)	196 (100%)
Not-for-profit	0 (0%)	27 (84.4%)	0 (0%)
<b>Specialisation</b>			
Mono-disciplinary	14 (8.3%)	4 (12.5%)	56 (28.6%)
Poly-disciplinary	155 (91.7%)	28 (87.5%)	140 (71.4%)
<b>Number of beds</b>			
< or = 29	0 (0%)	4 (12.5%)	196 (100%)
30–99	158 (93.5%)	16 (50.0%)	0 (0%)
> or = 100	11 (6.5%)	12 (37.5%)	0 (0%)
<b>Governance</b>			
Independent	150 (88.8%)	4 (12.5%)	190 (96.9%)
Corporate group	19 (11.2%)	4 (12.5%)	6 (3.1%)
Health network	0 (0%)	11 (34.4%)	0 (0%)
Under tutelage	0 (0%)	13 (40.6%)	0 (0%)
<b>Declared turnover (MAD)<sup>a</sup></b>			
Mean (SD <sup>b</sup> )	19 200 (13 800)	54 500 (46 900)	7 040 (4 740)
Median [Min <sup>c</sup> , Max <sup>d</sup> ]	14 500 [492, 87 700]	37 600 [2 920, 178 000]	7 470 [6.5, 55 900]
<b>Legal form</b>			
Commercial society	168 (99.4%)	5 (15.6%)	193 (98.5%)
Civil society	1 (0.6%)	0 (0%)	3 (1.5%)
NGO <sup>e</sup> or foundation	0 (0%)	14 (43.8%)	0 (0%)
Other	0 (0%)	13 (40.6%)	0 (0%)
<b>University status</b>			
Teaching center	0 (0%)	4 (12.5%)	0 (0%)
Non-teaching center	169 (100%)	28 (87.5%)	196 (100%)
<b>Population</b>			
Urban	160 (94.7%)	26 (81.3%)	169 (86.2%)
Rural	9 (5.3%)	6 (18.8%)	27 (13.8%)
<b>Region</b>			
Casablanca-Settat	63 (37.3%)	14 (43.8%)	42 (21.4%)
Rabat-Sale-Kenitra	27 (16.0%)	3 (9.4%)	38 (19.4%)
Marrakech-Safi	15 (8.9%)	4 (12.5%)	25 (12.8%)
Fes-Meknes	19 (11.2%)	1 (3.1%)	22 (11.2%)
Tanger-Tetouan-Al Hoceima	11 (6.5%)	7 (21.9%)	22 (11.2%)
Souss-Massa	11 (6.5%)	1 (3.1%)	18 (9.2%)
Beni Mellal-Khenifra	5 (3.0%)	1 (3.1%)	20 (10.2%)
Oriental	16 (9.5%)	1 (3.1%)	6 (3.1%)
Draa-Tafilalet	2 (1.2%)	0 (0%)	2 (1.0%)
Guelmim-Oued Noun	0 (0%)	0 (0%)	1 (0.5%)

<sup>a</sup>In thousands of Moroccan dirhams (MAD)<sup>b</sup>Standard deviation<sup>c</sup>Minimum<sup>d</sup>Maximum<sup>e</sup>Non-governmental organization

Cluster 2 is the smallest cluster including 32 private hospitals. The majority of hospitals are not-for-profit (84.4%) and poly-disciplinary (87.5%). The number of beds is medium to high with 37.3% of hospitals having 100 beds or more, 50% having between 30 and 99 beds and only 12.5% having less than 30 beds. In terms of

governance, most hospitals are under tutelage (40.6%) or in network (34.4%) and only few hospitals are independent (12.5%) or part of corporate groups (12.5%). Hospital turnover is high and ranges from 2.9 to 178 million MAD, with a mean of 54.5 million MAD and a median of 37.6 million MAD. In terms of hospital legal form,

most hospitals are NGOs or foundations (43.8%) or had other forms (40.6%), few hospitals are commercial societies (15.6%) and none is a civil society. 12.5% of hospitals are teaching centers. Most hospitals are in the urban area (81.3%) and mainly concentrated in the region of Casablanca-Settat (43.8%), followed by the region of Tanger-Tetouan-Al Hoceima (21.9%), the region of Marrakech-Safi (12.5%) and the region of Rabat-Sale-Kenitra (9.4%).

Cluster 3 is the largest cluster with 196 private hospitals. All hospitals are for-profit and mono-disciplinary (28.6%) or poly-disciplinary (71.4%). The number of beds is low with all hospitals having less than 30 beds. Regarding governance, most hospitals are independent (96.9%) and only 3.1% are part of corporate groups. The turnover of the hospitals is low and ranges from 6.5 thousand to 55.9 million MAD, with a mean of 7 million MAD and a median of 7.5 million MAD. The most common legal form is commercial society (98.5%) and only few hospitals are civil societies (1.5%). All hospitals are non-teaching centers. 86.2% of hospitals serve a predominantly urban population and 13.8% serve a predominantly rural population. Hospitals are well distributed over the national territory with 21.4% in the region of Casablanca-Settat, 19.4% in the region of Rabat-Sale-Kenitra, 12.8% in the region of Marrakech-Safi, 11.2% in the region of Fes-Meknes, 11.2% in the region of Tanger-Tetouan-Al Hoceima, 10.2% in the region of Beni Mellal-Khenifra, 9.2% in the region of Souss-Massa, 3.1% in the region of Oriental, 1% in the region of Draa-Tafilalet and 0.5% in the region of Guelmim-Oued Noun.

Therefore, three categories of private hospitals stand out. A first type which groups together for-profit hospitals, rather poly-disciplinary and independent, mainly commercial companies, with medium size and turnover. They are spread over the whole territory, but with a high concentration in large regions. A second type of private hospitals, which is mainly made up of non-profit hospitals, rather poly-disciplinary, in network or under tutelage, with medium to large size and high turnover. They are concentrated in large regions and may be university hospitals. A third type of hospitals is a group of private for-profit hospitals, rather independent, with small size and low turnover and well distributed over the territory.

Thus, the Table 3 shows that the variables which have the most significant discriminatory power in this segmentation are: the property, the number of beds, the turnover and the governance. The characteristics relating to the other variables studied are practically found in the three clusters. These four discriminating variables refer to three criteria (Table 1): the ownership, size of hospitals (beds and turnover) and governance. These criteria can be used for the classification of private hospitals in

LMICs which often do not have large databases of private health facilities.

### Sensitivity analysis

Figure 3 displays the distribution of hospitals in the three clusters. Observations (i.e. hospitals) are represented by points and variables have been transformed into two dimensions using principal component analysis. This representation shows the distribution of observations in the three clusters, represented on a Euclidean space. This sensitivity check confirms that the three private hospital clusters are distinct. We can thus consider that our clustering algorithm used is robust.

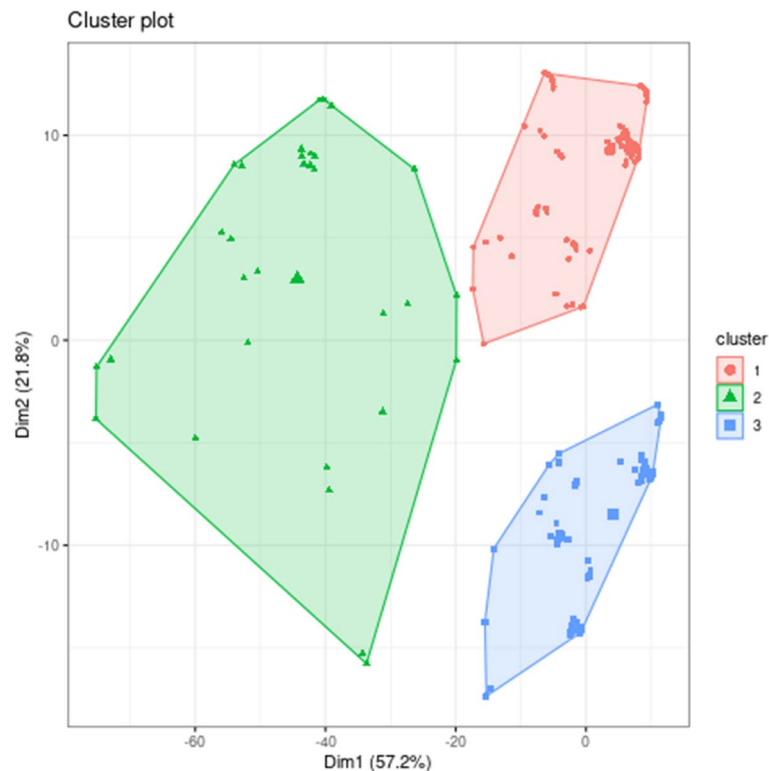
### Discussion

The private health sector plays an important and growing role in the healthcare systems of the LMICs. But significant gaps remain about its characteristics and development. Due to various demographic and epidemiological changes, the public sector has been overwhelmed with the demand for healthcare services, especially services provided by hospitals. This forced changes in health markets, which led to significant increases in private sector participation in healthcare delivery [3]. The international community, including the WHO, lacks a common framework for analysing the private health sector. It also lacks an evidence base from which to develop guidance on the types of services and activities where it might have a role or comparative advantage in strengthening health systems [9]. Whatever approach is taken to overcoming this obstacle, it must begin by understanding the rules that govern the organization and functioning of the private care sector.

Our study focuses on private hospitals, which are health facilities that contain a lot of equipment and consume a lot of resources, and whose use is costly for users and for the UHC. In Morocco, there are 397 private hospitals with 14 502 beds in 2021. They thus represent 70.6% of all hospitals (public and private) and 35.2% of the national capacity in hospital beds (excluding military hospitals). In addition, the private hospital sector is the preferred recourse for beneficiaries of compulsory health insurance [32]. Since 2022, this health insurance has been generalized to the entire Moroccan population. This makes knowledge of the private hospital sector useful for achieving universal access to healthcare and for regulating health insurance.

Almost all private hospital classifications have a legal rather than an empirical basis. To understand the organization and real characteristics of the private hospital sector in Morocco, we adopted a two-step approach in our study: (i) a descriptive approach based on a statistical analysis including ten variables identified through a review of the literature on hospital classification; and





**Fig. 3** Distribution of observations in the three clusters

(ii) an unsupervised learning approach based on clustering algorithm (k-means) to identify hidden patterns or groupings in our empirical data.

The first stage of analysis is the most common in the literature. It allowed us to better define the profile of private hospitals since it was based on ten variables, while the private hospital data collected by the Ministry of Health is based on only three variables: the ownership, the number of beds and the geographical site. Compared to Morocco, Tunisia has the same basis for describing the private hospital sector, with an additional criterion relating to specialization [33]. Due to lack of data, our descriptive analysis of private hospitals did not cover variables relating to human resources, medical technology and use of services, as is the case in the OECD database (OECD.stat) considered among the most important health databases [11]. Despite its importance, OECD.stat remains a general health database. Indeed, compared to our typology, the OECD database does not include key variables such as turnover, capital, governance and ownership, which are essential to describe the profile of private hospitals. This means that our analysis is more specific to the private hospital sector than that of the OECD. As for the WHO, its global health observatory has no data on private hospitals and its description of the hospital sector is limited to the overall density of beds [10]. Thus, the results of our descriptive analysis provide

a better understanding of the profile of private hospitals and their differential characteristics compared to public hospitals. They help identify gaps in healthcare coverage and guide healthcare planning. This better description of hospital profiles also makes it possible to draw cross-national comparisons. However, despite its importance, the private hospital sector is not considered in the analysis of healthcare systems at the global level.

According to the second stage of analysis, it was a question of building a typology by using a grouping algorithm based on our empirical data covering the entire national territory. The clustering method showed that it is possible to build a solid segmentation with only three criteria of similarity: ownership, hospital size (beds and turnover) and governance. Hospital size related criterion can be enriched by the use of data on staff, technology and on patients when they exist. In our study, we identified three main types of private hospitals. The first type is made up of for-profit, independent or group hospitals, which are medium in size and turnover. The second type is made up of large private, not-for-profit, under tutelage or networked hospitals with high turnover. The third type is made up of small, for-profit, independent, low-turnover hospitals.

In high-income countries, hospital clustering aimed to analyse trends in hospital organization (vertical and horizontal integration) [34]. Some countries have even

applied it to the public hospital sector [35]. Some high-income countries categorize private hospitals according to their function (general or specialist care; acute or long-term) or according to their legal status or ownership, such as in the United States, France or Germany. In the United States, due to the development of hospital groups, hospital segmentation is organized into systems and networks to inform health policy and practice, as well as research on the performance of different health groups and clusters [36]. In Morocco, the creation of hospital groups is a relatively recent phenomenon. Although it concerns 41 private hospitals, it did not impose itself as a cluster whatever the number  $k$  of groups explored with  $k$ -means algorithm.

Thus, this single two-step approach to analyse the private hospital sector, adopted by our study, appear to be comprehensive. The descriptive approach makes it possible to define the private hospital general profile based on specific variables identified and tested. As for the unsupervised learning approach, it makes it possible to build clusters of hospitals on the basis of attributes of similarities identified in a more objective way by clustering algorithm. This enables to systematically analyse similarities and variation as well as detect and interpret patterns for a better understanding of the dynamics of this sector which is still poorly understood in LMICs.

Our findings may have several implications for public authorities. This study provides valuable insights into the private hospital market in Morocco, which could be used to inform policy and decision-making in the healthcare sector. Understanding the characteristics and emerging typology of private hospitals can help to better regulate the private sector and to better plan its complementarity with the public sector. In addition, both in Morocco and in similar LMICs, private hospitals play an increasing role in the healthcare system, providing a substantial portion of healthcare services to the population, and playing a crucial role in achieving UHC. Clarke et al. highlight the importance of the private sector in UHC and consider that it is necessary to have political commitment and effective regulation to optimize its potential [9]. Fallah and Bazrafshan conducted a systematic scoping review of evidence from developing countries, examining the participation of private hospitals in delivering services towards UHC [37]. Siddiqi et al. draw lessons from country experiences to understand the role of the private sector in delivering health benefit packages of UHC [38]. These studies collectively underscore the significance of the private sector in the context of UHC, while also highlighting challenges and lessons learned from country experiences. Similarly, Jeurissen et al. suggested the role of public support and reimbursement strategies within UHC reforms in promoting the growth of the private sector in the United States, the United Kingdom, Germany,

and the Netherlands [22]. These lessons could inspire private sector growth in Morocco, from small physician-owned private hospitals to private hospital networks.

Overall, these studies highlight the heterogeneity of the private hospital sector in LMICs and the need to consider its diversity when designing health policies and regulations. In addition, the majority of these studies were descriptive and did not include a clustering algorithm of the data. Our study is the first in Morocco and among the few in LMICs to identify the typology of private hospitals using an unsupervised clustering approach. Another strength of our study is the use of a database that includes all private hospitals in the country. Our study also used a robust methodology and two-stage approach to categorize a new typology of the private sector hospitals that presents high contextual relevance for the ongoing implementation of UHC policy and health system reform in Morocco. In addition, the ten variables used considered a wide range of hospital characteristics that, to our knowledge, have never been analysed before in Morocco and in the LMICs. However, our study may have some limitations. A limitation is that our analysis did not include some important hospital characteristics, such as staffing, technology and utilization, due to the unavailability of these data. This shows the importance of feeding the routine information system with data from the private sector. Another limitation of our study is that our literature review was not comprehensive, but was based on a narrative review of typologies adopted by international organizations.

In LMICs, the private hospital sector is not sufficiently known. The data available to define its profile are insufficient to provide an understanding of its organization and the dynamics of its development. LMIC governments will find it difficult to define the role of this sector in improving access to healthcare and in moving towards UHC. The national information systems of these countries must therefore be strengthened and enriched with data on the private healthcare sector. In the meantime, studies similar to our can be considered to position and regulate the private hospital sector. We consider that the results of our study offer a starting point for adapting the regulation and governance of this sector in Morocco and in LMICs. However, our single case study is not sufficient to test the transferability of our typology. Further research needs to be carried out in other contexts to judge its generalizability to other similar LMICs contexts.

## Conclusions

In Morocco, the routine information system has few variables to describe the profile of the private hospital sector while it represents more than a third of all hospitals. We explored the characteristics and typology of the private hospital sector in Morocco using ten variables. Our

results show that the private hospital sector is organized into three types of hospitals according to three similarity criteria: ownership, size (beds and turnover) and governance. This typology contributes to the understanding of the development dynamics of this sector and can guide efforts to plan and regulate the supply and demand of care in the current context of the generalization of compulsory health insurance which makes the private sector open to beneficiaries of all medical coverage schemes. Our study has several policy implications. It offers policy-makers with a typology of private facilities that may guide the formulation of policies to enhance the growth of the private sector in order to improve regulation, supervision and the design of appropriate policies and incentives to increase quality of care, performance and accessibility of care within the context of UHC extension and decentralization reform.

#### Abbreviations

ISIC	International Standard Industrial Classification of All Economic Activities
LMICs	Low and Middle-Income Countries
MAD	Moroccan Dirhams
OECD	Organisation for Economic Co-operation and Development
UHC	Universal Health Coverage
WHO	World Health Organization

#### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12913-024-11660-2>.

Supplementary Material 1

Supplementary Material 2

#### Acknowledgements

None declared.

#### Authors' contributions

ABA and ND provided the data. IEB and SZ analysed the data. SZ and ABA wrote the manuscript. ZB, RB and SB edited the manuscript. All authors approved the final manuscript.

#### Funding

No funding received.

#### Availability of data and materials

The data that support the results of this study cannot be publicly available because the source of data did not provide permission to do so.

#### Declarations

##### Ethics approval and consent to participate

The data used for this study is retrospective, based on anonymized data, purely observational and do not involve humans. Therefore, the study does not require specific institutional review board approval and consent to participate, according to the Moroccan legislation (law number 28–13) [31].

##### Consent for publication

Not applicable.

##### Competing interests

The authors declare no competing interests.

Received: 29 September 2023 / Accepted: 26 September 2024

Published online: 14 October 2024

#### References

- Institute of Medicine. The New Health Care for profit: doctors and hospitals in a competitive environment. Washington, DC: National Academies; 1983.
- Griffin CC. Strengthening health services in developing countries through the private sector. Discussion Paper 4. Washington, DC: International Finance Corporation. 1989.
- Nah S-H, Osifo-Dawodu E. Establishing Private Health Care Facilities in developing countries: a guide for medical entrepreneurs. World Bank; 2007.
- Eggleston K, Shen YC, Lau J, Schmid CH, Chan J. Hospital ownership and quality of care: what explains the different results in the literature? *Health Econ.* 2008;17(12):1345–62.
- Herrera CA, Rada G, Kuhn-Barrientos L, Barrios X. Does ownership matter? An overview of systematic reviews of the performance of private for-profit, private not-for-profit and public healthcare providers. *PLoS ONE.* 2014;9(12):e93456.
- Weinberger M, Bellows N, Stover J. Estimating private sector out-of-pocket expenditures on family planning commodities in low-and-middle-income countries. *BMJ Glob Health.* 2021;6(4):e004635.
- World Health Organization - WHO. Working with the non-state sector to achieve public health goals. 2005. <https://apps.who.int/iris/handle/10665/69202> (Accessed: 4 Jun 2023).
- Morgan R, Ensor T, Waters H. Performance of private sector health care: implications for universal health coverage. *Lancet.* 2016;388(10044):606–12.
- Clarke D, Doerr S, Hunter M, Schmets G, Soucat A, Paviza A. The private sector and universal health coverage. *Bull World Health Organ.* 2019;97(6):434–5.
- World Health Organization - WHO. Global Health Observatory. 2020. <https://www.who.int/data/gho> (Accessed: 4 Jun 2023).
- Organisation for Economic Co-operation and Development - OECD. OECD. Stat. 2021. <https://stats.oecd.org/> (Accessed: 4 Jun 2023).
- Lavado RF, Ulep VGT, Pantig IMT, Ortiz DAP, Jimenez JF, Datu MBG, Banzon EP. Profile of Private Hospitals in the Philippines. Discussion Papers DP 2011-05. Philippine Institute for Development Studies. 2011.
- Romadon YW, Fitriah D. The comparative study on Clustering Method Using Hospital Facility Data in Jakarta District and surrounding areas. *Int J Mach Learn Comput.* 2019;9(6):749–55.
- Setiawan KE, Kurniawan A, Chowanda A, Suhartono D. Clustering models for hospitals in Jakarta using fuzzy c-means and k-means. *Procedia Comput Sci.* 2023;216:356–63.
- Mackintosh M, Channon A, Karan A, Selvaraj S, Cavagnero E, Zhao H. What is the private sector? Understanding private provision in the health systems of low-income and middle-income countries. *Lancet.* 2016;388(10044):596–605.
- Belrhiti Z, Van Belle S, Criel B. How medical dominance and interprofessional conflicts undermine patient-centred care in hospitals: historical analysis and multiple embedded case study in Morocco. *BMJ Glob Health.* 2021;6(7):e006140.
- Ministry of Health of Morocco. Health in figures 2021. [https://www.sante.gov.ma/Documents/2024/04/Sante%20en%20chiffre%202021%20VF%20\(2\).pdf](https://www.sante.gov.ma/Documents/2024/04/Sante%20en%20chiffre%202021%20VF%20(2).pdf)
- Competition Council of the Kingdom Of Morocco. Notice of the Competition Council concerning the competitive operation of the market for medical care provided by private clinics and similar establishments in Morocco. Rabat. 2022. <https://conseil-concurrence.ma/wp-content/uploads/2023/10/Avis-du-Conseil-de-la-Concurrence-Avis-A.4.22-FR-.pdf>
- Durán A, Wright S. Understanding hospitals in changing Health systems. Ed. Palgrave Macmillan; 2020.
- United Nations. International Standard Industrial Classification of all Economic Activities (ISIC) Rev.4. New York: United Nations; 2008. p. 252.
- Organisation for Economic Co-operation and Development - OECD. A system of Health accounts 2011: revised edition. Paris: OECD Publishing; 2017.
- Jeurissen PPT, Kruse FM, Busse R, Himmelstein DU, Mossialos E, Woolhandler S. For-profit hospitals have Thrived because of generous public reimbursement schemes, not Greater Efficiency: a Multi-country Case Study. *Int J Health Serv.* 2021;51(1):67–89.
- de Carvalho G, Schmid A, Fischer J. Classifications of health care systems: do existing typologies reflect the particularities of the Global South? *Global Social Policy.* 2021;21(2):278–300.
- Reibling N, Ariaans M, Wendt C. Worlds of Healthcare: a Healthcare System Typology of OECD Countries. *Health Policy.* 2019;123(7):611–20.

25. Ministry of Health of Morocco. Health care services in Morocco. 2021. [http://cartesanitaire.sante.gov.ma/dashboard/pages2/index\\_2021.html](http://cartesanitaire.sante.gov.ma/dashboard/pages2/index_2021.html) (Accessed: 29 Mar 2023).
26. Hartigan JA, Wong MA. Algorithm. AS 136: a K-Means Clustering Algorithm. *J Royal Stat Soc Ser C (Applied Statistics)*. 1979;28(1):100–8.
27. Gower JC. A general coefficient of similarity and some of its properties. *Biometrics*. 1971;27(4):857–71.
28. Foss AH, Markatou M, Ray BK. Distance metrics and clustering methods for mixed-type data. *Int Stat Rev*. 2019;87:80–109.
29. Kodinariya TM, Makwana PR. Review on determining number of Cluster in K-Means clustering. *Int J*. 2013;1:90–5.
30. R Core Team. The R Project for Statistical Computing. 2022. <https://www.r-project.org/> (Accessed: 4 Jun 2023).
31. Ministry of Health of Morocco. Law no. 28–13 on the protection of persons participating in biomedical research. 2015. <https://www.sante.gov.ma/Reglementation/REGLEMENTATIONDESPRATIQUESMEDICALES/28-13.pdf> (Accessed: 1 Jun 2023).
32. Ministry of Health of Morocco. National health accounts. 2018. p. 113.
33. Ministry of Health of Tunisia. Health care services in Tunisia. 2022. <http://www.santetunisie.ms.tn/fr/carte-sanitaire/carte-sanitaire-2011> (Accessed: 4 Jun 2023).
34. Thomas JW, Griffith JR, Durance P. Defining hospital clusters and associated service communities in metropolitan areas. *Socioecon Plann Sci*. 1981;15(2):45–51.
35. Chrusciel J, Le Guillou A, Daoud E, Laplanche D, Steunou S, Clément MC, Sanchez S. Making sense of the French public hospital system: a network-based approach to hospital clustering using unsupervised learning methods. *BMC Health Serv Res*. 2021;21(1):1244.
36. Nolte E, Pitchforth E, Miani C, Mc Hugh S. The changing Hospital Landscape: An Exploration of International experiences. *Rand Health Q*. 2014;4(3):1.
37. Fallah R, Bazrafshan A. Participation of delivering private hospital services in universal health coverage: a systematic scoping review of the developing countries' evidence. *J Educ Health Promot*. 2021;10:113.
38. Siddiqi S, Aftab W, Venkat Raman A, Soucat A, Alwan A. The role of the private sector in delivering essential packages of health services: lessons from country experiences. *BMJ Glob Health*. 2023;8(Suppl 1):e010742.

### Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.