

Entrepreneurship and Management in the Therapeutic Revolution: The Modernisation of Labs and Hospitals in Barcelona, 1880s–1960s

Abstract:

This article uses a business history approach to contribute, first, new empirical evidences about the diversity of ownership and management typologies in the health care system before the era of large public hospitals of the 1960s. Second, the article suggests that inefficient management can have a negative impact in health care systems, particularly significant in times of innovation and market expansion, something the article analyzes at the local level with a long-term business history perspective. The article presents new data that may contribute to debates about the supposed automatic link between increases in sanitary spending and improvements in welfare, that do not take into account managerial efficiency criteria.

Keywords: Healthcare; Blood; Plasma; X-rays; Barcelona; Disruptive Innovation; Entrepreneurship

Introduction

Long-term non-income evidence of global progress in equality and welfare has been closely related to health and well-being. The most important evidence in this regard would be an increase in life expectancy and a decline in infant mortality rates. The first most significant moment of decline in infant mortality rates and progress in life expectancy in the Western world took place between the 1870s and the 1930s, during the so-called ‘health transition’. These advances spread across the world from the 1940s until the 1990s, and have accelerated in the last two decades. There is a well established literature about the factors that determined this progress. Improvements in diet and water supply, sanitation, living conditions, salaries, and mothers’ education and literacy during the 1870s and until the late 1960s have traditionally been acknowledged as key drivers in the global improvement of health conditions in many regions of the world. The centralisation and organisation of healthcare institutions by civil authorities was also an important development, as well as the spread of medical and engineering ideologies promoting hygiene in large industrialised cities (Robles, García and Bernabeu 1996; Prados de la Escosura 2014).

Scientific and technological innovations to improve health conditions during this period emerged in the most developed economies and scientific centres. Before the 1940s, some particularly outstanding innovations included vaccines, X-rays, surgical rooms, ether for anaesthesia, clinical diagnosis, and the control of some infectious diseases through preventive campaigns focused on improving water infrastructures. After the 1940s, the key disruptive innovations in healthcare were penicillin, blood and plasma

storage and manufacturing, antibiotics and sulphonamides, together with the first organ transplants and the industrialisation and mass distribution of innovative products and technologies created since the 1880s. Despite their importance, there is relatively little known about the process by which technological and scientific innovation was transferred to society through private and public companies. Fragmented and dispersed information in publications from the History of Medicine, the History of Hospitals, and the History of the Pharmaceutical and Insurance Industries suggests that the process involved debates, resistances, difficulties, expenses, uncertainty, and risk.

In the Western world, the therapeutic revolution unfolded in pioneering centres and corporations in the most developed economies between the 1880s and the 1960s. In Spain, and particularly in large industrialised cities like Barcelona, this revolution developed during the same period, but with the interruption of the Spanish Civil War in the late 1930s. The history of several pharmaceutical firms and of government health policies between the 1880s and the 1960s has been relatively well studied. Research has also been carried out on the establishment of public hospitals and insurance companies (Medina Domenech 1993 and 1994; Pons and Vilar 2015; Fernández Pérez 2015 and 2016) and on technological innovations and patents developed by a few institutes of analysis and laboratories.

There have been relatively fewer studies concerning the management and financing of clinical institutes and laboratories or the management of private and public hospitals in large industrial cities like Barcelona during the crucial years when vaccines, microscopes, surgical rooms, clinical tests, blood transfusions, and the application of radiography for diagnosis (X-rays) and treatment were introduced and used among large numbers of patients. For developing countries, far from Germany, France, England, the United States, or Japan, the discovery of new drugs and advances in anatomy, neurology, and biology during and after the final decades of the nineteenth century created an abundance of scientific information that was not easy to obtain, understand, or apply, and even less so to transfer for the improvement of patient diagnosis and treatment. The link between professionals trained in new scientific knowledge and the improvement of the population's health conditions was not direct. Large hospitals equipped with modern medical innovations to treat thousands of patients appeared during the military conflicts of the first half of the twentieth century, in response to the needs created by the two World Wars, and again after the 1950s (Donzé 2017).

In pre-industrial times and until the beginning of the twentieth century, the provision of health services in Spain, as in most of Western Europe, was fragmented, inefficient, and badly regulated by the authorities, which considered health problems an issue of social order and not the basis for general welfare and progress. Physicians and pharmacists usually treated the wealthy, at the patient's or the physician's home, with no regulation of fees or tariffs and no control over the quality of their services. On the other hand, municipal and private charitable institutions attended to the basic needs of the very poor (often to avoid the spread of their illnesses to the rest of society) with very limited

resources and the scant voluntary assistance of a few physicians and surgeons from the schools or faculties of medicine (Hernández 1876). Most of the population, what we could call the working and middle classes of artisans, merchants, peasants, industrial workers, and the rest of society, rarely visited doctors or midwives in their homes or, and only in the case of flagrant poverty, in the socially marginalised public hospitals.

During the twentieth century, private and public firms in the urban centres of Western Europe started to invest time and resources in creating, enhancing, and disseminating disruptive scientific and technological innovations that improved health conditions and reduced mortality rates, thus contributing to social welfare. We know very little about these firms, their ownership, their management, their strategies, their structures, their evolution, or the obstacles they faced in the process of creating disruptive innovations in the healthcare industries and transferring them to society.

The present article aims to contribute to reduce this gap by studying entrepreneurship and management in healthcare firms in Barcelona between the 1880s and the 1960s. The goal is to analyse the diversity of pathways followed in a large industrial city of Southern Europe during the years of disruptive scientific and technological innovation in the world's healthcare industries. This research demonstrates the influence of different types of ownership and organisational structures on the transfer of the medical innovations of the time to firms and through them to patients.

Sources include a variety of unpublished archival material from private and public hospitals and laboratories in two very different healthcare branches: blood banks and plasma fractionation and X-ray technology.

In the next section, the article presents the context of the increase in life expectancy in Barcelona and the dissemination and development of disruptive innovations that took place in the city between the late nineteenth century and the 1960s. The following sections focus on two in-depth case studies (the Grifols private laboratory of analysis and the semi-public Hospital de la Santa Creu i Sant Pau) and one less in-depth case study (Clínica Corachan), examining the diverse models of entrepreneurship and management that developed in these prominent private and public healthcare companies in Barcelona during this period. The aim is to analyse the significance of ownership structures and the degree of professionalization of the management in explaining the different speeds and complexities involved in the adoption of innovations in healthcare companies during the so-called health transition in the Western world, using the example of an industrialised European city.

One case study analyses family owned and managed clinical labs, through the strategy led by the Grifols family dynasty, which began modern clinical blood analysis in 1910 and set up a modern laboratory for diagnosis in 1940. The family patented one of the first processes to produce penicillin in Spain in the early 1940s, founded the first civilian blood bank in Spain in 1945, and established a pioneering joint venture with the leading US American Hospital Supply Corporation in 1960. The archival evidence

consistently demonstrates that over fifty-five years (1910–1965) they adopted enduring and flexible family ownership strategies open to the participation of foreign pioneering scientific and managerial professionals. This flexibility allowed them to ingrain innovative structures and strategies into the firm over decades.

The following case study analyses the introduction of X-ray technologies and radiography in a private hospital (Clínica Corachan) and a very large hospital owned by a private institution which was in fact controlled by two local public institutions (Hospital de la Santa Creu i Sant Pau).

Medical sciences and industrial applications in Catalonia, 1880–1960

The nineteenth century was a period of social, economic, demographic, ideological, and technological changes and transformations in Catalonia (Corbella and Calbet 1973). In terms of health, the nineteenth century and the first third of the twentieth century were characterised by recurring epidemics or outbreaks of cholera, yellow fever, typhoid fever, malaria, and the spread of tuberculosis. The shortage of public hospital facilities (Mer I Guell 1933) stimulated the creation of private clinics (Col·legi Oficial Metges de Barcelona 2014 and Clínicas a Barcelona 2015), which competed to have the latest technical innovations. Medical training was theoretical until the emergence of the so-called ‘medical generation of 1888’, influenced by the foreign ideas of innovation and modernity (Corbella, 1970; Sabaté, 2013). Yet the nineteenth century in Catalonia was a time of changes, growth, and transformation. There was an awakening of collective capabilities, a mobilisation of human and economic resources, and a yearning for progress and internationalisation. This wave of creative vitality became even more obvious and tangible in the last third of the nineteenth century. Between the 1880s and the 1960s, Barcelona witnessed the sharpest increase in life expectancy in its history; the key sign of the health transition.

Improvements in diet and water quality played a key role, as elsewhere, in the improvement of life expectancy. However, the dissemination of innovations by a growing number of medical and pharmaceutical professionals graduated from local public universities also had a considerable influence on improving the health conditions of the population and on spreading the fruits of the therapeutic revolution: the diagnosis of infectious diseases using the microscope and clinical analysis; the concentration of surgeries in special rooms to protect from infections; the use of anaesthetic products to reduce pain; new surgical practices for traumatology, gynaecology, odontology, and blood transfusions; and the introduction of radiation technologies (X-rays) for the diagnosis and treatment of illnesses.

The first step was the introduction of medical news and innovations from abroad. This reveals Spanish professionals’ knowledge of foreign medical literature at the time, as well as the contacts they had overseas allowing them access to products. A few names are worth mentioning. Francesc Piguillem i Verdacer (1771–1826) was a practitioner in

the rural town of Puigcerdà when he introduced E. Jenner's 'vaccine' to Spain in 1800 (Sabaté and Calbet, 2016). He was in close contact with the Medical School of Montpellier and he got the lymph for the vaccine from Paris. After that, he moved to establish himself in Barcelona. In 1817, he was appointed to chair of medicine. In 1820, just one year after its invention, he published information on a new instrument for the direct auscultation of the chest in the general newspaper *Diario de Barcelona*. The instrument had been created in Paris by Dr Laennec. He explained that he had one of these instruments, called a *pectorilógio* or *estenoscòpic*, which he presented to Mr Pelegrí Forés, expert turner in Barcelona (Regomir St.) and a member of the city's *Academia Nacional de Ciencias Naturales y Artes*, in order to reproduce and sell it to interested professors, physicians, and studious youth, because nobody could distinguish between the original and the perfect reproduction.

The ideological battles between conservatives and liberals, as well as the civil wars of this period, forced some doctors into exile in France or Britain. They took advantage of the situation to learn new medical knowledge and practices, which were imported on their return to Spain. This was the experience of Pere Mata, who introduced modern toxicology, and Antoni Pujadas i Mayans, who introduced hydrotherapy and also revamped psychiatric assistance through his own enterprise.

In the year 1865, Joan Giné i Partagas (Calbet and Corbella, 1982) became professor at the Medical School of Barcelona. He had a very clear positivist mentality and he wanted to change the teaching method through the participation of the students. He promoted and defended some practical learning initiatives: *Societat d'Emulació per als Estudis Anatòmics* (Learned Society for Anatomical Studies); *l'Institut Mèdic de Barcelona* (Barcelona Medical Institute), the first attempt to establish a free medical school guided by the principles of experimentation and not of authority; and the *Societat Mèdica 'El Laboratorio'* ('The Laboratory' Medical Society). He was the first to introduce his pupils to the use of the microscope.¹ He also introduced antisepsis² and promoted the early use of X-rays in Barcelona.³

Jaume Ferran i Clua introduced and was the main representative of so-called 'laboratory medicine'. He was a scientist with a variety of interests. First of all, he practiced ophthalmology with a focus on optics and carried out experiments in photography together with his friend Innocent Paulí i Galcerán. In 1879, they published the book *La Instantaneidad en Fotografia*, with two important advances: the substitution of gelatin for starch and the possibility of using flexible paper as a support instead of rigid glass. The first manufacturers to use these novelties were the German G.J. Junk and the American Kodak.⁴ Both friends also established the first telephone connection between Tortosa and Tarragona in 1878. Their collaboration extended to the field of electricity with the invention of the microphone, which was not patented due to lack of official and private support.⁵ But the most important medical advance in Spain by the last quarter of the nineteenth century was the introduction of the cholera vaccine in 1885; the first

¹ Sabater Coromines, *La Independencia Médica*, 1/2/1872.

² *El Compilador Médico*, 25/9/1865.

³ *La Independencia Médica*, 5/3/1896.

⁴ Tió i Sauleda S. *Ferran i Paulí. La Instantaneidad en Fotografia*, (Barcelona: Càtedra UNESCO de Tècnica i Cultura, 2007).

⁵ J. Ferran and I. Paulí, "Estudios sobre el micrófono con objeto de establecer su teoría," *Crónica Científica* II 27 (1879): 49–51.

effective human bacterial vaccine. Ferran established a microbiology laboratory in his home, at his own expense, until the municipality of Barcelona created its own laboratory in 1887 (Roca, 1988).⁶

In 1879–1880, Ramon Coll i Pujol, chair of Physiology at the Faculty of Medicine in Barcelona, presented a new device to facilitate blood transfusion⁷ that functioned as an external heart. It was built and marketed by Mr Clausolles of Barcelona.

In the field of anaesthesia, we can find several examples of improvements and collaborations between medical professionals and companies. In 1869, the dentist Josep Maifrén installed a piece of anaesthetic equipment in his clinic that he himself had modified and that improved on the existing Duchesne and Sprangue models. In 1889, Antonio Morales Pérez, chair of surgery at the University of Barcelona, presented his *termoeterizador*, used to practice anaesthesia with warm ether. In 1892, Alfredo Diaz, from the Hospital de la Santa Creu, presented his modification of Morales' model, called the *electro-termo-eterizador*, which used electricity to heat and move the anaesthetic ether. Dr Jeroni Estrany was a clever medical mechanic and electrician, working on new devices and improving others, including the design of a stethoscope that was then marketed. The otorhinolaryngologist Ricard Botey was a very prolific creator and modifier of instruments for his specialty. Sebastià Recasens, obstetrician and gynaecologist, designed and constructed an inhaler for the delivery of anaesthesia that could be used with only one hand (Hervás and Cahisa, 1993).

The multiplication of innovations was possible, among other reasons, because of the need for new doctors. The population of the city in 1879 was 600,000 people, and almost double that in 1935 with 1,048,641. Between the latter year and 1960, the population increased by half a million inhabitants to 1,557,863. Municipal studies from the second half of the nineteenth century demonstrate that in Barcelona, as in other industrialised cities of Western Europe during that century, there were some districts where mortality rates were higher than and sometimes double the rates of other healthier districts in the city.

From medieval times until the late nineteenth century, the largest public hospitals had been concentrated in the districts near the sea and the harbour, where mortality rates had been traditionally higher. After the 1890s and throughout the 1900s–1930s, new private clinics and public hospitals quickly abandoned these parts of the city and moved to new healthier districts and buildings in an area today called the Eixample. The largest public hospitals, which nowadays can admit around 60,000 patients per year, treated on average around five to six thousand people per year in the first three decades of the twentieth century. Most of the patients were poor people without resources and their treatment was financed by irregular and insufficient public and private charity.

⁶ A. Roca i Rosell, *Història del Laboratori Microbiològic Municipal de Barcelona: de Ferran a Turró* (Barcelona: Ajuntament de Barcelona, 1988).

⁷ R. Coll y Pujol, *Un nuevo transfusor* (Barcelona: Imprenta Barcelonesa, 1880).

Table 1. Public hospitals in Barcelona in the period 1902–1920, according to the *Anuario Estadístico de la Ciudad de Barcelona*

Hospital	1902		1910		1915		1920	
	Number of new patients registered	Number of beds	Number of new patients registered	Number of beds	Number of new patients registered	Number of beds	Number of new patients registered	Number of beds
Hospital de la Santa Cruz (15 th century...)	7050	ND	5449	ND	5606	ND	6020	ND
Hospital Militar	4836	ND	2733	ND	3870	ND	5786	ND
Hospital Clínico de la Facultad de Medicina de Barcelona (1906)			3132	ND	4799	ND	5585	ND
Hospital de Ntra Sra del Sagrado Corazón de Jesús (1879)	644	ND	692	ND				
Hospital de Niños Pobres	4525	ND	200	50	ND		13756	ND
Casas de Socorro (free first-aid clinics)	5452	ND	6728	ND	6546	ND		
Hospital Homeópata del Niño Dios	75	30						
Higiene Especial del Gobierno Civil	169	ND						

Source: Own elaboration from the *Anuario estadístico de la ciudad de Barcelona*. Digitalised version, Biblioteca de Catalunya, <http://mdc2.cbuc.cat/cdm/search/collection/estadistbcn/lang/es> (accessed Jan.–Feb. 2016).

There was an increase in the number of graduates from Barcelona’s Faculty of Medicine and Pharmacy and the internationalisation of their libraries and syllabi allowed them to follow innovations in France and the United Kingdom, which would in turn help with the development of vaccines against traditional epidemics and infectious diseases. These close international connections were not new. They had spread with the establishment of a Bourbon dynasty linked to France in the eighteenth century and multiplied in the nineteenth century.

Table 2. Average annual growth rate of licensed physicians and pharmacists in Barcelona, 1895–1962

Year	Licensed physicians (COMB)	Annual growth rate licensed physicians BCN	Licensed pharmacists Catalonia (Jordi i González 1997)	Annual growth rate pharmacists CAT
1895	383	1.00	107	1.00
1895–1928	2000	5.14	762	6.13
1928–1962	4421	2.36	1786	2.54

Source: Own elaboration from Archivo Histórico y Biblioteca del Col·legi Oficial de Metges de Barcelona (COMB) and an email from its director with data prepared by the Col·legi (18/02/2016). For pharmacists: Jordi i González, 1997.

Note: Annual average growth rate calculated using data from the COMB and Jordi i González 1997.

Many undergraduates had the opportunity to learn about or apply new products and techniques in the city's public hospitals where usually only a few appointed senior doctors regularly visited and treated the sick, accompanied by their young students.

There were a few distributors of imported medical and clinical instruments in Madrid, Barcelona, Bilbao, Seville, and Valencia in the early twentieth century, according to records from the *Anuario Financiero de Sociedades Anónimas*, the *Guía Médica de España*, and the *Guía Médica de Cataluña*. In terms of the manufacture and sale of medical and laboratory instruments in Barcelona, besides imports from foreign manufacturers, there were attempts to develop an emerging local industry throughout the nineteenth century and the first decades of the twentieth century. As early as 1830, Pau Clausolles (of French origin) had opened an establishment in the El Raval district in Barcelona, near the largest public and religious hospitals, to sell medical instruments and to market devices designed by local health professionals. The establishment was advertised as a manufacturer of all types of surgical instruments and as a supplier to the Medical School. Later on, he was succeeded by his son, Josep Clausolles Pontet (Perpignan 1825–Barcelona 1907), who transferred the business to 30 Santa Anna St. in the city centre and opened a branch in Madrid. He published and illustrated the magazine *Revista ilustrada de instrumental quirúrgi* (Calbet 2013)⁸ at the end of nineteenth century. Also worth mentioning is Emili Clausolles, perhaps Pau's son, who opened a medical equipment distribution business in 1880. In 1902, he published a complete catalogue of the instruments they sold. Around 1916, the Clausolles enterprise was succeeded by Valls, Jordana i Cía. Another significant medical firm at the beginning of the twentieth century in Barcelona was Industrias Sanitarias S.A. (previously Casa Hartmann). The medical

⁸ JM Calbet Camarasa, *Prensa sanitària a Catalunya (1763-1939)* (Manresa: Publicacions de l'Arxiu Històric de les Ciències de la Salut/COMB, 2013).

instruments firm José Herrera: *Indústria de Material Médico-Quirúrgico* was established in 1923 in Barcelona, at 157 Provenza St., very near to the Medical School. Herrera was a skilful craftsman who produced most medical and surgical instruments for almost all specialties, or improved devices designed or invented by local surgeons or physicians. The introduction of pneumothorax surgery to treat pulmonary tuberculosis during the period 1920–1940 allowed the Bazar Médico Pareras Pujol from Barcelona to make and sell a portable local model. Other builders, sellers, or representatives of medical devices during the 1920s and 1930s in Barcelona include: Anglo Española de Electricidad, at 12 Pelayo St., and J. Serrallach.

The consolidation of modern medicine in Catalonia accelerated during the period 1906–1936 with significant medical advances. The first study undertaken in Barcelona with the aid of electrocardiography was carried out by Pi Sunyer and Bellido in the laboratory of the Physiology Department of the Faculty of Medicine and presented at the V International Congress of Medical Electrology and Radiology in Barcelona and the VIII International Congress of Physiologists held in Vienna, both during 1910. Polygraphs were known about in Catalonia since the end of the nineteenth century, but due to difficulty of application and lack of accuracy their use was not widespread. Later, the recording of arterial and venous pulses joined the electrocardiogram in one single graph in order to improve the study of cardiac function.⁹ In the *Institut d'Estudis Catalans* (1907), the first branch institution of the Science Department was the *Societat de Biologia de Barcelona*, created in 1912. Its first president, A. Pi Sunyer, and its first secretary, J.M. Bellido, together with Ramon Turró from the *Laboratori Municipal*, created a genuine scientific forum, making great progress in the fields of experimental microbiology, immunology, physiology, and pharmacology. On the other hand, and in a fruitful symbiosis with the University of Barcelona, the Commonwealth (*Mancomunitat*) of Catalonia created the *Institut de Fisiologia*, which opened its doors in April 1921 and where many productive medical research studies were carried out (Corbella 2009). Numerous papers resulting from experimental work with laboratory animals and humans were presented at national and international congresses.

After the Spanish Civil War, the country became economically isolated for political reasons. This situation was overcome through the local production of medical goods. The principal firm in this period was José Herrera's. He was able to reproduce and improve some models from abroad and to create original devices according to the needs of the different growing specialties. Anaesthesia was one of the fields his company supplied. Dr José Miguel Martínez, head of the anaesthetic service in the Hospital de la Santa Creu i Sant Pau, created the O.M.O. inhaler in 1946. José Herrera's company was responsible for manufacturing and marketing the new device, which was widely accepted for many years. Later on, the anaesthetist Josep Pons Mayoral adapted the O.M.O. inhaler to be used with a new anaesthetic halothane. In 1961, Dr Miguel designed a new 'H-M2' auto-inhaler, also built by the Herrera factory and much used by obstetricians in deliveries because of the patient's own control over the flow (Hervás

⁹ E. Murillo Palacios, "Instrumentos Nuevos," *Gaceta Medica Catalana* II (1888): 138–139. A. Pi Sunyer and JM Bellido, "La electrocardiografía. Sus fundamentos, su técnica, sus aplicaciones experimentales y clínicas," *Terapia* 5 (1913): 505–527, 652–667, 761–796.

2006). There were also innovations in other branches of the medical profession. The otorhinolaryngologist Josep Prades Pla, not satisfied with the Camus mask for tonsillectomy, made some changes that improved the former device, creating his own model that was used for many years. During the 1960s, psychiatrists started to employ electroshock therapy for the treatment of some conditions. In addition, a hospital technician who worked in the maintenance of encephalographs manufactured portable units of his own creation, and Casamajor, a radio manufacturer in Barcelona, built a device with a faradic-galvanic current for psychiatric uses.

X-Rays, clinical analysis, new surgical rooms, and blood banks are innovations that were rapidly introduced in Barcelona and that significantly improved the diagnosis and treatment of illnesses. The invention of X-rays was registered in Germany by Wilhelm Röntgen in 1895, and the first public X-ray trial in Barcelona was carried out by Cesar Comas in 1896 at the Faculty of Medicine (Medical Photography Department). Trials were also carried out in the Hospital Provincial de Madrid in 1903. The first firm in Spain to use X-rays for diagnosis and radiology for the treatment of sick people was the *Gabinete Radiológico* opened by Cesar Comas in 1905. At that time, according to the press, the cost of one X-ray was around five Spanish pesetas, approximately half a day's salary for the average worker (*ABC* and *La Vanguardia* reference). Stationary and mobile surgical rooms were tested and improved during the First World War and their use spread rapidly among open-minded medical doctors in Barcelona and Madrid between those years and the early 1960s: Manuel Corachan in 1915, P. Huguet Puigderrajols, Dr Cardenal, Sanatorio Quirúrgico Sant Ricart, and Jaume Planas. Clinical analysis laboratories were introduced in hospitals and in private clinics and they used microbiological analysis to test a variety of illnesses with microscopes and chemical reagents made with animals and plants. Blood banks, on the other hand, began to be designed in the United Kingdom and Russia in the 1910s–1920s in response to the needs created by World War I. Between 1927 and 1934, some doctors tried to imitate British and Russian innovations in blood collection and storage, but unsuccessfully (Institut de Fisiología Joaquim Trias, 1927) as a team from the Hospital Clínic experimented with creating a blood bank following the ideas of the Russian Sergi Judine after his visit to Barcelona in 1934. The first blood bank in Spain that could successfully and safely achieve the mass collection, storage, and transportation of blood was launched during the Civil War of 1936–1939 under the direction of F. Duran i Reynals, a student from the pre-war Hospital Clínic team interested in Judine's experiments in blood banks. Two of Duran's students that helped him in the wartime blood bank would open the first civilian blood bank in Spain after the end of the war. These students were José Antonio Grifols Lucas and Víctor Grifols Lucas and they opened the establishment in Barcelona in 1945 with the support of their father, lab owner José Antonio Grifols Roig. They would soon start a network of 'subsidiaries' in other cities (Badalona and Valencia) in response to the absence of a public network for blood donations, the need for blood transfusions, and the demand for such services among doctors and hospitals.

Clinical analysis and the modern blood industries: the Grifols family businesses, 1910–1965

The development of blood banks and blood transfusions was initiated by doctors who had specialised in clinical analysis. Clinical laboratories were a medical innovation that had spread in Western Europe and the United States only at the end of the nineteenth century with Louis Pasteur and Heinrich Hermann Robert Koch's revolutionary discoveries in microbiology. Their methods contributed to finding vaccines against cholera, tuberculosis, and many infectious diseases, thus greatly reducing mortality rates in the world and increasing life expectancy.

The first clinical laboratories in Catalonia were developed by amateurs Jaume Ferran i Clua and Innocent Paulí i Galcerán after their studies in the Jesuit library at the Observatori Astronòmic de l'Ebre in Tortosa. Ferran and Paulí had no studies in medicine but frequently read the *Comptes Rendus* of the Société Royale des Sciences de Paris (a scientific journal in which Pasteur usually published his findings) (reference here). Ferran studied the new findings in microbiology by himself and wrote an article about paludism. In Marseilles, he studied the 1884 cholera outbreak as well as its causes and treatment methodologies. In 1887, he recommended opening what would become the first municipal microbiology laboratory in Barcelona in order to apply his knowledge and experience to the prevention and treatment of mass infectious diseases in the city.

Modern clinical laboratories would become firmly established in Barcelona by the late 1880s, helping the public authorities prevent or control cholera, paludism, and other infectious diseases. It was a favourable context for young graduates in Medicine to open their own labs. José Antonio Grifols Roig established his lab in 1910 after finishing his studies in Medicine in 1909 and working for a few months in labs in Munich to learn about updated clinical analysis from professors at the University of Munich and in German laboratories. He opened the *Instituto de Análisis Clínicos* in the city centre, in Plaça Urquinaona, with three colleagues who were doctors or lab specialists (Luis Celis, Ricardo Moragas, and Dr Gordan, former director of the Bacteriology Department in Danzig). The three shared technical and managerial responsibilities as well as ownership until 1923. The Institute carried out biological research with the latest German technologies, developing preventive vaccines against typhoid fever, cholera, Mediterranean fever, and others. They also carried out Abderhalden and Wasserman tests for the diagnosis of illnesses like syphilis and other venereal diseases that were very common in Barcelona at the time among patients entering public and religious hospitals (Grifols 2011; Hospital de la Santa Creu i Sant Pau Archive, *Libros Mayores* 1921 and 1935). Their reputation and prestige were soon consolidated and the increase in clients (private doctors, hospitals, and patients) encouraged them to invest the profits and move to larger premises on the Rambla de Catalunya, near Provenza Street, in 1923. This was during the time when almost 30 clinics and institutes in the city had decided to move from downtown to, or open brand new clinics in, the healthier districts of the

Eixample, far from the unhealthy harbour. Their success and the growth of their own families led the three Spanish partners to split and pursue individual enterprises. Grifols Roig would be the only owner, director, and technical expert of his new firm: *Instituto Central de Análisis Clínicos, Bacteriológicos y Químicos*. He would combine this activity with directing the histopathology laboratory at the Hospital de la Santa Creu, teaching haematology in the Academy of Medical Sciences of Barcelona, and doing an internship in the laboratory of the Faculty of Medicine: a typical combination of private, public, professional, and teaching activities that was practiced by medical professionals in Barcelona at the time, and still is today.

The Barcelona-based trading house Casa Ganzer provided him with most of the clinical instruments and most of the clients were doctors who needed a clear diagnosis before recommending treatment to their patients. Grifols employed five doctors and chemists to help him in the technical tasks of the laboratory; four Spaniards and one German (Hellmut H. Hempel). In 1925–1926, his experience in blood extraction led him to begin trying his hand at blood transfusions (Grifols, 2011: 22–23).¹⁰ Grifols would preserve the friendship and scientific cooperation with his first partners: Luis Celis Pujol became full professor of Histology and Anatomical Pathology at the Faculty of Medicine of Barcelona in 1923, and Ricardo Moragas became director of the Laboratory of Bacteriology and Serology at the Hospital de la Santa Creu and owned a private clinical analysis laboratory.

From 1928, activities in blood transfusion, collection, and the manufacture of plasma derivatives would increasingly become the focus of entrepreneurship and innovation in Grifols' company. That year, he presented a new indirect method for blood transfusion at the Catalan Academy of Medical Sciences and in 1929 he presented new studies about blood groups on the Iberian Peninsula. In 1933, he revealed his new device (*flébula*) for safe blood transfusions at the Vilafranca del Penedès Hospital. That same year, and in 1934, the leading directors of the three most important public hospitals in Barcelona required his services: Pedro Pons from the Hospital Clínic; Dr Ribas from the Hospital de la Santa Creu i Sant Pau; and Dr Clara from the Quinta de Salut l'Aliança.¹¹ His team of experienced professionals and his reputation were noteworthy and between the late 1920s and the 1930s he registered many new incremental innovations to promote his method of indirect blood transfusion (*flébulas*, gauzes, and ampoules).

The laboratory produced new clinical devices with registered patents, vaccines (against typhus and diarrhoea), and nutritional products. German and Spanish experts in clinical analysis and in the production of microbiological products cooperated with Grifols (Dr Walter Oppenheimer, Dr Hirsch, Hempel, Cantó, and Cuevas). His two sons, José Antonio Grifols Lucas (born 1917) and Víctor Grifols Lucas (born 1919), grew up in the lab and from a very young age their father taught them to help him perform urine

¹⁰ Historical Archive Museu Grifols in Barcelona. Hemobanco de Laboratorio Grifols S.A., Memoria. Reference 6353.

¹¹ Historical Archive Museu Grifols in Barcelona. Hemobanco de Laboratorio Grifols S.A., Memoria. Reference 6353.

and glucose tests, or even the Wasserman test when José Antonio was 17 and Víctor was 15 (Grifols 2011:40). After the end of the Civil War in 1939, Grifols now had two young sons helping in the lab and in 1940 the Institute was substituted by a new family firm adapted to the evolution of the business and of the family: *Laboratorios Grifols S.A.*, with Grifols Roig and his wife Magdalena Lucas as the first shareholders. The goal of the firm was to supply clinical services and to manufacture dry plasma, a new product with few specialised labs, which could significantly multiply the output of each blood donation.¹²

In 1944, and in the context of agreements with the new SOE (compulsory health insurance) to supply blood to the national system of hospitals and labs (where no blood donations or collections existed), expectations of steady growth in profits led the business to move to a new building that was considerably larger, allowing a more strict division of activities (vaccines, analysis, rabbit testing) and maintaining the administrative office in the apartment on Las Ramblas. Grifols registered several patents with the support of his collaborator Walter Oppenheimer and his sons: the instrument for indirect transfusion in 1928 and 1929; a process to dry plasma in 1943; a table to register blood groups in 1949; the brand ‘Banco de Sangre y Plasma’ in 1950; and several products to improve blood extraction and fractionation in 1957, 1961, 1964, 1965, and 1966.¹³

Grifols then decided to open the first civilian blood bank in Spain in 1945: the Hemobanco.¹⁴ In order to maintain the lab’s reputation, Grifols decided that he would only be manager of *Laboratorios Grifols S.A.* and that his son José Antonio would manage the new blood bank. From 1945 until 1960, the blood bank performed around 200,000 blood extractions, a volume that made the family decide to reinvest profits from the two family firms in a new plant for blood extraction in Badalona, a city near Barcelona. Their experience in blood collection, preservation, storage, and manipulation led the father and sons to experiment with dry plasma and plasma fractionation to obtain and separate proteins with which to produce different plasma-derived products. Plasmapheresis was patented in June 1965 and it was soon used for plasma extraction in Spain and in the United States.¹⁵

Table 3. Blood banks (B.B.) and plasma fractionation (P.F.) across the world

COUNTRY	PIONEER	DATE B.B.	DATE P.F.
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¹² Archivo de Protocolos de Barcelona. Not. D. Cruz Usatore y Gracia. Copia de la Constitución de la Sociedad *Laboratorios Grifols S.A.* ante el que fue Notario de esta Ciudad Dn Jose Faura Boras en 18 de noviembre de 1940. Archivo Museu Grifols. Escrituras. Reference 59763.

¹³ Historical Archive Museu Grifols in Barcelona. Hemobanco de Laboratorio Grifols S.A., Memoria. Patentes relacionadas con la actividad del banco de sangre. Reference 6353.

¹⁴ Historical Archive Museu Grifols in Barcelona. Hemobanco de Laboratorio Grifols S.A., Memoria. Reference 6353; and *Laboratorios Grifols S.A.* Banco de Sangre y Plasma. Funcionamiento económico. Reference 03178.

¹⁵ Historical Archive Museu Grifols in Barcelona. Hemobanco de Laboratorio Grifols S.A., Memoria. Reference 6353.

UK	British Red Cross	1921	
USSR	Sergei Yudin	1930	
Spain	Frederic Duran i Jordà	1936	1951 (Grifols)
USA	Edwin Cohn/Armour Labs (later, Baxter)	1940	1940
Germany	Emil von B./ Behringwerke	1939?	1946
Australia	William Penfold/ CSL	1929	1952
Switzerland	ZLB	1939	1949
Japan	Ryoichi Naito/ Green Cross	1950	1971
Argentina	Laboratorio de Hemoderivados	1914?	1964/74

Source: Own elaboration from secondary sources from each corporation in the table.

The investments involved in moving to a larger building, multiplying the registration of patents on innovations, and maintaining a highly qualified team of experts, which now included two adult sons graduated in Medicine and Pharmacy, prompted José Antonio Grifols Roig to expand the business's capital. He decided to include a client, businessman, and friend, Domingo Brasó, as a new partner. His two young sons also became partners together with their father, their mother, and Brasó. In 1946, Laboratorios Grifols S.A.'s capital increased from 500,000 pesetas to 1,000,000 pesetas to finance the expansion of its activities.¹⁶ Brasó, and later on his son, would be shareholders in the business until the early 1990s. Times were very tough for the country's economy, with post-Civil War scarcities making investments or innovation difficult. Grifols was a unique exception among small labs since it had begun developing and investing in innovative activities in the early 1910s. The father's entrepreneurial attitude was carried on by his sons. Víctor Grifols travelled to England in 1946 (one year after the end of World War II and the same year that Brasó entered the family firm) to explore new products as well as potential alliances with British subsidiaries of North American corporations like British Hayden in order to jointly produce penicillin in Spain. On that same trip, Víctor Grifols visited the Royal Pharmaceutical Society, distinguished Spanish doctors in exile like Trueta, Gabarró, and

¹⁶ Historical Archive Grifols in Sant Cugat. Escrituras. Escritura 1.109, de aumento de capital, 9 de mayo de 1946.

Duran i Jordà, and British firms producing medical instruments and products like Burroughs Wellcome & Co.¹⁷

Grifols was friends with the owner of a pharmacy in Barcelona, Ricardo Roca de Viñals, who was a distributor for the North American company Dade Reagents (Miami, Florida) in Spain. In the mid-1950s, this friendship facilitated conversations about exporting Grifols sera to the United States in exchange for imports of reagents and other products for Grifols' and Roca de Viñals' firms. Rigid intervention in foreign payments and currency in Spain before 1959 made confidential agreements based on trust and reliable networks necessary in order to begin the first monthly exports of Grifols plasma-derived products to Dade Reagents in the United States during 1957 and 1958.¹⁸ The importance of this foreign trade lay more on the qualitative side than in the quantitative value, since the goal was for the Spanish firms to keep abreast of the most updated technology in clinical analysis in the United States in the 1950s and to learn how to establish a win-win alliance with a leading partner in that country. These contacts provided an early understanding of how to undertake international activities in the small lab, which would allow for further agreements with Dade Reagents and the American Hospital Supply Corp. (two leading manufacturers and distributors of hospital supply equipment) when the joint venture Dade Grifols was established in 1961.

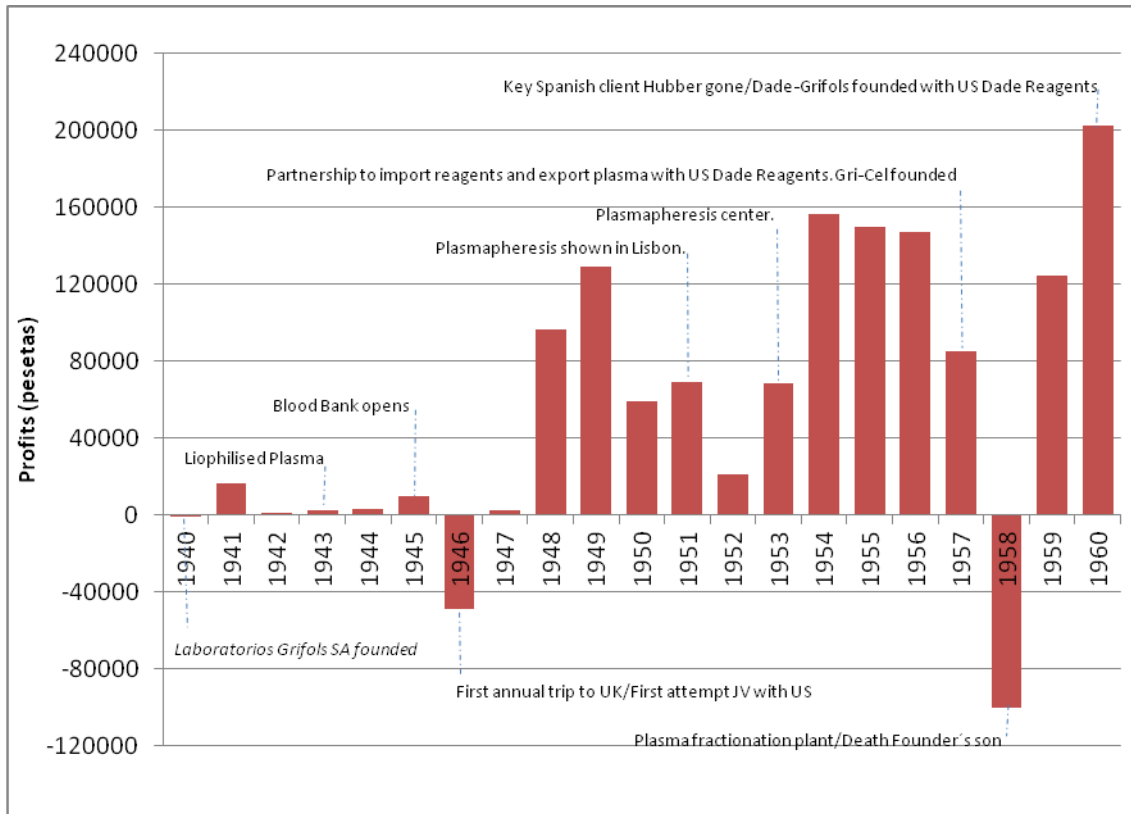
In 1969, Víctor Grifols wrote that his Catalan most important client Hubber had started investments to vertically integrate the production of plasma in their own factory in 1965, reducing the amount of plasma bought, and that they had been formally pressing the Spanish Ministry of Health to forbid plasma exports probably to integrate the industry in Barcelona and get rid of Grifols.¹⁹ Grifols' sales at home declined, stocks piled up, and exports were legally forbidden by the government. Could have been the end. They decided forward vertical integration strategy, a counter-attack: to produce plasma derivatives. The costs of growing in scale and scope were met with a joint venture with American Hospital Supply Corp. The joint venture was signed in 1961 and would lead, in the late 1960s, to the construction of the modern US-style factory in Parets del Vallès, one of the leading factories in the global plasma industry today. The internationalization of Grifols before 1960s was an attempt to overcome a poor domestic market, but right after 1965 when the government prohibited plasma exports, it was the only solution to survive the competition at home by seeking strength with powerful foreign partners with whom to grow and strengthen competitive resources of the firm.

¹⁷ Historical Archive Museu Grifols in Barcelona. Memoria sobre el viaje a Inglaterra realizado por Víctor Grifols del 12 de julio a 22 de agosto de 1946. Reference 05898.

¹⁸ Historical Archive Museu Grifols in Barcelona. Letter from J.M. Potts, vice president of Dade Reagents Inc., to J.A. Grifols Lucas of Hemobanco, 8 January 1958; and confidential letters between Grifols and Dade Reagents, 1957–1959. References 2331, 2354, 2357, and 02978.

¹⁹ Historical Archive Museu Grifols. Letter from Víctor Grifols to Joe Potts of Dade Reagents Inc., 29 March 1969, p. 2. Reference 869.

Figure 1. Laboratorios Grifols 1940-1960. Profits and Key Historical Events



Source: Own elaboration from Grifols' Historical Archives in Barcelona and Sant Cugat del Vallès, Balance Sheet Accounts 1940–1960.

The diverse pathways leading to the introduction of radiation and X-rays in public and private hospitals in Barcelona, 1921–1950: Hospital de la Santa Creu i Sant Pau and Clínica Corachan

Large hospitals and small clinics in Barcelona grew in numbers after the urban expansion of the city in the late 19th century. Possibly the following list includes the most important ones: Hospital de la Santa Creu i Sant Pau (founded in 1401, merging six previous hospitals of medieval civil and religious origins) moved from El Raval to the Eixample between 1904 and 1930; the Casa de la Caritat (1802) and the Casa Provincial de Maternitat i Expòsits (1853–1884; moved to the Eixample in the latter year). Hospital del Sagrat Cor in 1881; Clínica Fargas in 1884–1892; Casa de Maternitat in 1891–1915; Clínica Ginecològica Dr Queraltó in 1898; Clínica Manaut in 1901; Hospital Clínic in 1906; Institut Municipal de Maternologia in 1913; Clínica del Remei in 1920; Clínica Corachan in 1921; Hospital de l'Esperança in 1922; Clínica Maternal de Camèlies in 1928; Hospital de la Santa Creu i Sant Pau in 1930 (construction of new structures in the Eixample, 1902–1930); Institut Policlíníc Plató in

1933; Clínica Mater (Santiago Dexeus) in 1935 (moved to Paseo Bonanova in 1972); Clínica d'Operacions Isidre Boguñà in 1935; Clínica del Dr Seguí in 1935; Clínica Dr Reverter in 1935; Clínica Ginecològica Dr V. Conill in the 1930s; Clínica de Tocoginecologia Dr J.M. Andreu Bayer in 1936; Clínica/Centre d'Oftalmologia Barraquer in 1941; Hospital de l'Esperança in 1945; and Hospital Vall d'Hebron in 1966.²⁰

X-rays were introduced in Barcelona very early, by the cousins Comas and Prió in 1896, only one year after their invention by W. Röntgen in Germany. The medical class enthusiastically embraced the new devices. Manuel Corachan declared in 1924 that:

Our facilities have all of the possible means required for the clinical task, such as: a laboratory for histological and chemical analysis, as well as for disinfection and asepticisation, a photography gallery, X-rays, surgical arsenal, etc. Today, I must add something else: the installation of a deep radiotherapy machine that produces ultraviolet rays and radium for curietherapy [...]. Today, it is indispensable for surgeons to have, together with enough quantities of radium, full facilities for deep radiotherapy in order to treat neoplasia that is inaccessible to the scalpel or to complete the healing of a person who has undergone recent surgery. Everybody knows the outstanding relevance and the significant increase that cancer treatment has demonstrated because of these two elements.

(Anales de Cirugía de la Clínica Corachan. Barcelona, January 1924. Corachan performed 1,500 surgeries in Barcelona between 1921 and 1923, around half in the Hospital de la Santa Creu where he was a visiting doctor and the rest in Clínica Corachan).

The clustering of hospitals and clinics in Barcelona created opportunities for the spread of new diagnosis and treatment technologies among public and private firms. Five of the ten first private radiology clinics in Spain concentrated their services in Barcelona.

Table 4. The first *gabinetes radiològics* in Spain

Year	Director	Name	City
1897	Espina y Capo, Antonio	Laboratorio Radiografía de A. Espina y Capo	Madrid
1897	Pujol y Camps, Joaquín		Barcelona
1898	Comas y Prió, C. y A.	Gabinete Radiológico Comas y Prió	Barcelona
1898	Carriazo, Felipe		Sevilla

²⁰ After the 1960s, the map of hospitals in Barcelona expanded with huge central hospitals and specialised clinics: Clínica de Cirurgia Plàstica i Estètica Planas (1971); Institut Dexeus (1972) (previously Clínica Mater); Hospital de Bellvitge (1973); Hospital de Sant Joan de Déu (1974); Hospital del Mar (1981); and Hospital Germans Trias i Pujol (1986). For a contextualization of Catalan hospitals in the emergence of modern Spanish hospitals, Vilar and Pons "La construcción de la red de hospitales y ambulatorios públicos en España 1880-1960" DT-AEHE N°1609.

1899	Mitjavila Cid, 286		Madrid
1902	Decref, J.		Madrid
1903	Comas y Prió, C. y A.	Gabinete Radiológico Comas y Prió	Barcelona
1905	Calatayud		Valencia
1919	Hospital Sagrado Corazón	Servicio de Rayos X	Barcelona
1930	Comas, César	Despacho, departamento de consulta	Barcelona

Source: Own elaboration from Portolés Brasó, 2004: 526–549.

Public hospitals arrived late, though not by much, to the introduction of the new technology. After the opening of the ground-breaking laboratory in the Faculty of Medicine in 1896, X-ray equipment was installed in the Hospital General de Madrid in 1899; in the Laboratorio Röntgen of Hospital Clínic/Faculty of Medicine of Barcelona in 1906/1907; in the Hospital de la Santa Creu i Sant Pau in 1913; in the Casa Provincial de Maternitat i Expòsits de Barcelona in 1918; and in the Casa Provincial de Caritat in 1925 (Portolés 2004 and Medina Domenech 1994).

German manufacturers were the preferred suppliers of the best X-ray equipment, specifically the Reiniger house and, after the merger in 1924, Siemens:

Table 5. X Rays in Madrid before the Civil War, 1909-1928

<p>X-ray gross sales in Madrid 1909-1914 (including all electro-medical devices, in 1000 Reichsmark) by Reiniger, Gebbert & Schall (largest X-ray device producer that merged with Siemens in 1924):</p> <p>1909–1910: 86.4 (2.1% of total) 1910–1911: 104.1 (2.4%) 1911–1912: 176.2 (3.5%) 1912–1913: 69.7 (1.3%) 1913–1914: 64.5 (0.9%)</p>
<p>X-ray gross sales in Madrid 1924-1928 (including all electro-medical devices, in 1000 Reichsmark) by Siemens-Reiniger:</p> <p>1924: 1021.3 (4.8%) 1925: 1271.6 (4.2%) 1926: 1000.4 (4.5%) 1927: 1129.2 (4.4%) 1928: 1366.7 (4.9%)</p>

Source: *Siemens Medical Archives, Erlangen, 18500: Umsatz und Bestelleingang (Mappe 1)*. Generously provided to the author by Pierre-Yves Donzé (e-mail message, June 14, 2016).

Note: In the 1920s, Madrid was one of S-R's largest foreign markets alongside Buenos Aires, Vienna, and Prague. Barcelona's hospitals and private clinics bought products and post-sales services directly from Germany or through Madrid-based distributors.

The *Anuario Estadístico de la Ciudad de Barcelona* provides data on the number of patients that entered each large public hospital in the city during the years 1901–1921, indicating that the capacity on average in each hospital was around 5,000–6,000 people per year (today, large hospitals in Barcelona have multiplied this capacity tenfold, reaching a yearly average of around 60,000 patients). If we compare the number of radiology services provided in each hospital during those years, there is an enormous contrast between the Hospital Clínic (a brand new hospital founded in 1906 to serve the Faculty of Medicine), with almost 80,000 services, and the 8,000 services delivered by the Hospital de la Santa Creu i Sant Pau:

Table 6. X Rays in Barcelona 1898-1930. Radiology services provided in large hospitals in Barcelona, 1898–1930

1898–1930	H. Sta Cruz y S. Pablo	8,287
1898–1929	Hospital Clínic	78,920
1909–1930	H. Sagrado Corazón de Jesús	212
1924	Casa Maternitat i Expòsits	0
	Casa Prov. De Caridad	0
Total		87,419

Source: Own elaboration from Portolés Brasó, 2004: 526–549.

The reasons that may explain why in almost thirty years only 8,000 radiology services were provided and in 1924 only around 900, in contrast with the 78,000 services provided in the Hospital Clínic during the same years, are complex (Medina Domenech 1994). They could include the fact that between 1904 and 1906 until 1930, the Hospital de la Santa Creu gradually moved from the old district of El Raval (Fargues I García and Tey I Freisa 2015). Also, one could consider the fact that the Hospital de la Santa Creu was a charitable foundation and therefore its goal could have been exclusively to feed the poor and help them die. However, a closer look at their *Libros Mayores* (general ledgers) and *Libros Diarios* (daybooks) suggest that the priority of the hospital managers between the 1880s and the 1960s was not to adopt improvements in the diagnosis, analysis, and treatment of patients but rather to maintain the building and its routine operations.

From 1401 until 1966, the Hospital de la Santa Creu i Sant Pau had a managerial board with four members; two appointed by the local cathedral and two appointed by the local city hall (Fargues i García and Tey i Freisa 2015). This set-up changed during the Civil War, but reverted back to the original managerial formula when the war ended. The four managers did not work in the hospital on a daily basis, but visited the facilities on average once a week to authorise investments, take decisions, and get reports from the appointed administrative staff that carried out the daily routines. The managers never included anyone who had graduated in Medicine, Pharmacy, or Chemistry, or anyone with any previous experience in the management of hospitals or laboratories. They appreciated the voluntary work of doctors that treated poor patients in the hospital, their

donations, which included technological equipment for diagnosis and treatment, and their legacies, but they did not ask for their technical opinion when taking decisions about investments (Fargues and Tey 2015; Hospital de la Santa Creu i Sant Pau Historical Archive. *Libros Mayores*, 1921, 1935, 1945, 1959, and 1955). They were accountable only to the bishop and the city mayor. From the late 1880s until the early 1960s, their goal was to organise activities to maintain a steady income from private legacies and donations, to manage assets or shares that provided regular income to the establishment, and to deal with institutions and authorities to try to obtain subsidies. On a very secondary plane, their goals included control of medical visits to sick patients, which were irregular and carried out on a voluntary basis by doctors from the Faculty of Medicine and their students. They delegated the treatment of patients who were suffering different illnesses to different doctors with no coordination between them. Another very secondary goal was to keep an eye on the techno-medical innovations spreading in other hospitals and labs in the city. The maintenance of the large number of servants attending to the building's upkeep and repair and the provision of food for the patients took up a large portion of the budget every year, during the years for which records have been preserved (1921–1955). Managers were aware of but could not easily solve frequent complaints received about doctors treating private patients in the hospital's facilities, doctors failing to visit sick people, sexual harassment, and robberies, particularly of expensive lab products like X-ray tubes or elements of X-ray devices, often donated by doctors and wealthy donors, rendering them inoperative.²¹

Table 7. Hospital Budgets in Barcelona 1921-1955. Annual income and spending at the Hospital de la Santa Creu i Sant Pau (in current Spanish pesetas)

Years	Income	<i>Resultas</i> of income	Spending	<i>Resultas</i> of spending
1921	2836609.29	1453513.84	835548.83	222089.53
1935	3523606.54	1591262.82	2025002.22	1726544.09
1945	6842750.77	1023305.47	5473223.55	916412.30
1950	13036156.50	4884458.03	22045806.11	
1955	22885491.93		43139553.23	

Source: Own elaboration from Historical Archive of the Hospital de la Santa Creu i Sant Pau in Barcelona, *Libros Mayores* and *Libros Diarios*, 1921, 1935, 1945, 1950, and 1955.

The *Libros Mayores* reveal that before the war, the administration of pious bequests was the hospital's major source of income, and that after the war there was a combined increase in donations from local wealthy industrialists and merchants plus a spectacular increase in public subsidies from governmental agencies; thus the rise in income and spending. Before the Spanish Civil War, the spending priorities had been focused on the construction, maintenance, and repair of a very expensive infrastructure, a jewel of the Modernist movement in Europe, which was made up of many small units that were badly (though beautifully) connected by underground tunnels (cold, very long, and terrible in the case of medical emergencies). After the war, the priority was no longer the maintenance of the building, but the treatment of the patients. This change in the

²¹ Hospital de la Santa Creu i Sant Pau Historical Archive, *Libros Mayores*, 1921 and 1935.

volume of income and spending and these different investment decisions are summarised in the table below.

Table 8. Investment in medico-technological equipment and staff in the Hospital de la Santa Creu i Sant Pau 1921-1955 (current Spanish pesetas)

	1921	1935	1945	1950	1955
Medical staff (<i>personal facultativo</i>)	57843.74	120224.83	142966.4	1851148.69	2934084.35
Students doing internships in Medicine and Surgery	29492.87	56520	15147		
Healing materials (<i>materiales de curación</i>)	142557.29	95172.24	331645.27	7706710.62	12620161.5

Source: Own elaboration from Historical Archive of the Hospital de la Santa Creu i Sant Pau in Barcelona, *Libros Mayores* and *Libros Diarios*, 1921, 1935, and 1945.

Notes: For 1950 and 1955, the *Libros Mayores* do not provide disaggregated information. ‘Healing materials’ include materials for laboratory and clinical analysis, such as microscopes, and components of X-ray equipment, radium, and radium tubes donated by local manufacturers and doctors to treat neoplasia. These materials were very expensive and were frequently the target of robberies in the hospital.

X-rays were possibly the most expensive technology in the Hospital de la Santa Creu i Sant Pau during these years. The 1935 *Libro Mayor* indicates how each X-ray device was paid for in 20 monthly instalments, and that each repair of a component of the device was a considerable expense in the hospital’s budget. This would explain the meagre 8,000 radiology services that were provided in this hospital during the two decades before the Spanish Civil War, ten times less than the services of their young competitor, the public Hospital Clínic. That non-professional management criteria of this institution, not a broader problem in the city, was the key reason explaining the limited radiology services and poor spending is revealed by the fact that in 1931 there were up to 31 private radiology clinics in Catalonia providing daily services at an average price of five pesetas per service, most of them concentrated in Barcelona and two in Reus (*Guía Médica de Catalunya*, 1931).

Final remarks

When public sanitary spending is low or non-existent, ownership structures and management styles may have a significant influence in the speed and efficiency through which firms transfer health care innovations to society. In this way, managers can have an influence in the dynamics of welfare. Before the era of the public health care systems and the large health care corporations historical sources are scarce, but they do exist, particularly at the local level. This research analyses some aspects about the management of the largest hospital, and two small health care firms, in the city of Barcelona, between the end of the nineteenth century and the 1960s.

The account books of the Hospital de la Santa Creu i Sant Pau, and information from their corporate and scientific boards, reveal that managerial structures controlled by non-learned managers hindered the possibilities to transfer innovations and to improve the life expectancy and welfare of patients in the largest hospital of the most industrial city of the country. Before the Civil War the managers of the Hospital focused spending on the basic needs of the patients and above all on paying the invoices of “contratistas” to which they outsourced the construction of the new pavilions sponsored by private sponsors. In the 1920s doctors and architects unsuccessfully claimed the managers to stop outsourcing the works, as “contratistas” spent 50% of the money spent by the hospital in sculptures and art, and charged 30% more of the proposed budget, thus increasing the hospital debt and deficit endlessly. This situation may easily explain the extraordinarily low acquisition of new medical devices, like X-Rays and radium for therapy, for which there was almost no money left in Santa Creu, right at the time when X-Rays and radium, and microscopes for clinical analysis, were bought in private clinics and labs for wealthy patients in the outskirts of Barcelona. The Hospital de la Santa Creu i Sant Pau was, and is, a tremendously beautiful landmark of European Modernism, but its ledgers and daybooks reveal that it was a terribly inefficient infrastructure from a medical and managerial point of view: it was not at all innovative and it did not facilitate smooth connections and flows of patients, doctors, and materials between units. Architectural beauty for the glory of the owners and the sponsors was the most important goal to achieve, by looking at the accounting books before the Civil War. The irony is that it was during the 1940s and 1950s, when innovation abruptly declined in the city due to the Civil War and the exile, and the hospital suffered considerable financial difficulties, when the most investments were geared towards scientific and technological innovations to improve patients’ health.

On the other hand, private health care firms that adopted a direct managerial control led by scientists-entrepreneurs, pioneered or closely followed scientific health care innovations. In the archival records of the Grifols laboratory and the Clínica Corachan from the 1920s and early 1930s, no complaints about robberies of X-ray or lab equipment by employees or patients were registered, as it was the case in the minutes of the Hospital de la Santa Creu I Sant Pau. The owners of the small lab and the small clinic were well-known doctors in the Barcelona Faculty of Medicine, who personally controlled, alone or with hired professionals, the economic management of the firm, and who spent more than 10 hours a day in their businesses supervising, controlling, and taking decisions that reduced uncertainty and risk in every small task, before and after the Civil War.

Path dependent institutional constraints determined a limited introduction of scientific or technological innovations that could have potentially improved patients’ life expectancy, in the central decades of the therapeutical technological revolution, before the 1940s. The privately owned and managed Clínica Corachan’s internal bulletins from the 1920s and early 1930s reveal that the private ownership and management was, as in the case of the private clinical lab owned and run by the Grifols scientific family dynasty, the key factor that allowed for a more modest but much more efficient design of the buildings and a rapid investment in modern surgical rooms, X-ray machinery, and the electrical installations required for X-rays and clinical analysis.

Managerial efficiency was, therefore, an essential factor that determined innovation transfer and long-term investments in the health care district of Barcelona, among small private firms. The absence of such managerial efficiency in large semi-public hospitals of the district, was in contrast the main reason behind the missed opportunity to transfer innovation and potentially improvements in welfare to the poorest sectors of the city, not the lack of sanitary spending.

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Sources

Biblioteca de Catalunya, *Anuario estadístico de la ciudad de Barcelona*. Digitalised version, <http://mdc2.cbuc.cat/cdm/search/collection/estadistbcn/lang/es> (accessed Jan.–Feb. 2016).

Grifols Academy of Plasmapheresis/Academia Grifols. “Annual Report.” Available in the Grifols corporate archive and through the Grifols website, 2009, 2010, 2011, 2012, 2013, 2014, and 2015. Accessed 2016. <https://www.grifols.com/es/web/international/home>

Grifols’ Historical Archives in Barcelona and Sant Cugat del Vallès, Balance Sheet Accounts 1940–1960.

Historical Archive of the Hospital de la Santa Creu i Sant Pau in Barcelona, *Libros Mayores* and *Libros Diarios*, 1921, 1935, 1945, 1950, and 1955

References

Broggi, M., 2006. *Revista Catalana d’Història de la Medicina*: 210.

Calbet Camarasa, J.M., 2013. *Prensa sanitària a Catalunya (1763-1939)*. Publicacions de l’Arxiu Històric de les Ciències de la Salut/COMB, Manresa.

Calbet J.M. and J. Corbella, 1982. *Diccionari Biogràfic de Metges Catalans*. Fundació Salvador Vives Casajuana/Seminari Pere Mata U.B., Barcelona.

Catalan, J., 2014 "El círculo virtuoso de Grifols, 1909-2013: I+D+I y éxito global desde el clúster médico-farmacéutico de Barcelona", *Revista de Historia de la Economía y de la Empresa*, 15, pp. 27-64.

Clínica Corachan., 1924. *Anales de Cirugía de la Clínica Corachan, Dr Manuel Corachan*. Clínica Corachán, Barcelona.

Coll y Pujol R., 1880. *Un nuevo transfusor*. Imprenta Barcelonesa, Barcelona.

Col·legi Oficial de Metges de Barcelona, 2015. *Cliniques a Barcelona*. Col·legi Oficial de Metges de Barcelona, Barcelona.

- Col·legi Oficial de Metges de Barcelona, 2014. *L'especialització en medicina a Catalunya*. Col·legi Oficial de Metges de Barcelona, Barcelona.
- Corbella, J. and J.M. Calbet, 1973. "L'evolució del pensament mèdic català en el segle XIX." *Anales de Medicina* monograph no. 2 vol. 59, pp. 183–206.
- Corbella, J., 1970. "La generación médica del 88 en Cataluña." *Actes I Congrés Internacional d'Història de la Medicina Catalana*, Barcelona, vol. IV, pp. 331–332.
- Corbella J., 2009. *L'Institut de Fisiologia de Barcelona (1920–1939)*. Institut d'Estudis Catalans, Barcelona.
- Coromines Sabater. 1872. *La Independencia Médica*, 1/2/1872.
- Chaqués, L., 1999. "Políticas públicas y democracia en España. La política farmacéutica del franquismo a la democracia." PhD diss., Universitat de Barcelona, Barcelona.
- Chandler, A.D. Jr., 2005. *Shaping the Industrial Century: The Remarkable Story of the Evolution of the Modern Chemical and Pharmaceutical Industries*. Harvard University Press, 2005, Cambridge MS.
- Conde Rodelgo, V., 2001. "Los últimos 20 años de los Centros Sanitarios en España." *Arbor* 170, 670, pp. 247-275.
- Donzé, P.-Y., 2005. "Les systèmes hospitaliers contemporains, entre histoire sociale des techniques et business history." *Gesnerus* 62, pp. 273-287.
- Donzé, P.-Y., 2017. *Histoire des politiques hospitalières en Suisse romande*. Editions Alphil/Presses Universitaires Suisses, Neuchatel.
- Fernández Pérez, P., 2016. "Laboratorios Andrómaco: Origins of the First Subsidiary of a Spanish Pharmaceutical Multinational in the United States (1928–1946)." *Journal of Evolutionary Studies in Business* 2, 1, pp. 266–275.
- Fernández Pérez, P., forthcoming. "Partners in a Journey to the Center of the World. Spanish and Japanese Alliances in the Healthcare Businesses 1960s-1980s". *Business History*.
- Ferran J. and I Paulí, 1879. "Estudios sobre el micrófono con objeto de establecer su teoría." *Crónica Científica* II 27, pp- 49–51.
- Fridenson, P., 2015. "Japanese-French business encounters since 1952: two opposite relations." *Entreprises et Histoire* 80, pp. 36–56.
- Grabuleda Teixidor, C., 2002. *Salut pública i creixement urbà. Política i acció social en el sorgiment de la Barcelona contemporània*. PhD diss., Universitat Pompeu Fabra, Barcelona.
- Grifols, 2015. *When a Dream Comes True: An Illustrated History of 75 Years of Grifols*. Grifols, Barcelona.
- Hernández Iglesias, F., 1876. *La Beneficencia en España*. Establecimientos Tipográficos de Manuel Minuesa, Madrid.

- Hervás Puyal C. and M. Cahisa Mur, 1993. “Ciencia e Industria: aportacions de professionals sanitaris i fabricants de Catalunya al utillatge anestesiològic.” *Gimbernat* XIX, pp.143–151.
- Hervás Puyal C., 2005-2006. *Autarquia, anestèsia i la necessitat de solucions pràctiques immediates*. Servei d’Informació Col·legial, Barcelona.
- Jordi i González, R., 1997. *COLECTANEA de “speciers”, mancebos boticarios, boticarios farmacéuticos, farmacéuticos practicantes de farmàcia y farmacéuticos en Catalunya. (1207-1997)*. Fundació URIACH 1838, Barcelona.
- Medina Domenech, R.M., 1994. “Nacimiento e institucionalización del ejercicio especializado de la radioterapia en el Hospital de la Santa Cruz y San Pablo”, *Medicina & historia: Revista de estudios históricos de las ciencias médicas*, 53, pp.1-16.
- Medina Domenech, R.M. 1993. “Estrategias profesionalizadoras en el origen de una especialidad médica. El caso de la radioterapia española (1895-1936)”. Tesis doctoral. Universidad de Granada, Granada.
- Mercadal O. and E. Quilez, 2016. *La Festa de l’Estany*. Ajuntament/Museu Cerdà, Puigcerda.
- Mer i Guell, M., 1933. *El problema de l’hospitalització a Barcelona*. Imp. La Ibèrica, Barcelona.
- Murillo Palacios E., 1888. “Instrumentos Nuevos.” *Gaceta Medica Catalana* II, pp. 138–139.
- Pi Sunyer A. and J.M. Bellido, 1913. “La electrocardiografía. Sus fundamentos, su técnica, sus aplicaciones experimentales y clínicas.” *Terapia* 5, pp. 505–796.
- Piguillem F., 1820. *Diario de Barcelona*, 17/10/1820.
- Piguillem F., 1802. “La vacuna vindicada o aviso interesante al público sobre esta inoculación” *Diario de Barcelona* 4/2/1803.
- Pons, J. and M. Vilar Rodríguez, 2014. *El seguro de salud privado y público en España. Su análisis en perspectiva històrica*. Prensas Universitarias de Zaragoza, Zaragoza.
- Portolés Brasó, F. 2004. “Fotografía y radiología en la obra del Dr. César Comas Llabería.” PhD diss., Universitat de Barcelona, Barcelona.
- Prados de la Escosura, L., 2014. “Capitalism and Human Welfare,” in *Cambridge History of Capitalism* 2, ed. L. Neal and J.G. Williamson, Cambridge University Press, Cambridge, pp. 501-529.
- Robles, E., F. García Benavides, and J. Bernabeu, 1996. “La transición sanitaria en España desde 1900 a 1990.” *Revista Española de Salud Pública* 70, 2, pp. 221-233.
- Roca i Rosell A., 1988. *Història del Laboratori Microbiològic Municipal de Barcelona: de Ferran a Turró*. Ajuntament de Barcelona, Barcelona.
- Sabaté i Casellas, F. and J.M. Calbet i Camarasa, 2016. *Personatges de la sanitat cerdana*. Edicions Salòria, La Seu d’Urgell.

- Sabaté i Casellas, F. 2013. *Els estudiants de medicina de la Universitat de Barcelona. Un estímul de progres*. Publicacions i Edicions de la Universitat de Barcelona, Barcelona.
- Santesmases, M.J., 1999. *Antibióticos en la autarquía. Banca privada, industria farmacéutica, investigación científica y cultura liberal en España 1940-1960*. Programa de historia económica, documento de trabajo 9906. Fundación Empresa Pública, Madrid. (www.funep.es/phe/hdf9906.pdf)
- Tió i Sauleda S., 2007. *Ferran i Paulí. La Instantaneidad en Fotografia*. Càtedra UNESCO de Tècnica i Cultura, Barcelona.
- Vilar, M. and J. Pons, 2016. *La construcción de la red de hospitales y ambulatorios públicos en España 1880-1960*. Documento Trabajo. Asociación Española de Historia Económica, N°1609.