

Online Branding in the Healthcare Industry: A Quantitative Analysis on How the World's Best Smart Hospitals Promote their Brands through Mobile Apps

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Abstract

Artificial intelligence, big data, telemedicine and mobile apps contribute to enhance hospitals' internal processes as well as patients' medical outcomes. This technology represents an opportunity to make hospitals' brands more credible. This paper analyzes how smart hospitals use mobile apps to improve their relations with stakeholders and promote their brands. To do that, we conducted a literature review about artificial intelligence, hospitals' branding strategies and mobile apps; then, based on this review, we defined 36 branding indicators; subsequently, we resorted to the World's Best Smart Hospitals 2023, an annual ranking developed by News-

week and Statista, to analyze how the 300 best smart hospitals in the world managed mobile apps for branding purposes according to these 36 indicators. Our results proved that 57% of hospitals managed mobile apps for communication purposes, but only few of them used these platforms to interact with different stakeholders such as employees (32,7%) and media companies (2,3%), and this way build the organization's brand in a collective way. We concluded that hospitals should follow a branding logic, develop apps for different stakeholders and explain why using these platforms is consistent with the organization's brand.

Keywords: Hospitals; Corporate communication; Brand; Reputation; Mobile Apps

Online Branding no Sector da Saúde: Uma análise quantitativa sobre a forma como os melhores *smart hospitals* do mundo promovem as suas marcas através de aplicações móveis

Resumo

A inteligência artificial, o big data, a telemedicina e as aplicações móveis contribuem para melhorar os processos internos dos hospitais, bem como os resultados médicos dos doentes. Esta tecnologia representa uma oportunidade para tornar as marcas dos hospitais mais credíveis. Este artigo analisa a forma como os hospitais inteligentes utilizam as aplicações móveis para melhorar as suas relações com as partes interessadas e promover as suas marcas. Para tal, realizámos uma revisão da literatura sobre inteligência artificial, estratégias de branding dos hospitais e aplicações móveis; em seguida, com base nessa revisão, definimos 36 indicadores de branding; posteriormente, recorreremos ao World's Best Smart Hospitals 2023, um ranking anual desenvolvido pela News-

week e pela Statista, para analisar a forma como os 300 melhores hospitais inteligentes do mundo geriam as aplicações móveis para fins de branding de acordo com esses 36 indicadores. Os nossos resultados provaram que 57% dos hospitais geriam aplicações móveis para fins de comunicação, mas apenas alguns deles utilizavam estas plataformas para interagir com diferentes stakeholders, tais como colaboradores (32,7%) e empresas de comunicação social (2,3%), e desta forma construir a marca da organização de uma forma colectiva. Concluímos que os hospitais devem seguir uma lógica de branding, desenvolver aplicações para diferentes stakeholders e explicar porque é que a utilização destas plataformas é consistente com a marca da organização.

Palavras-chave: Hospitais; Comunicação corporativa; Marca; Reputação; Aplicações móveis

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1. Introduction

Hospitals face different challenges such as limited budgets, patients' new requirements or stricter legal frameworks. The most important one consists of managing information and communication technologies (ICT) to accelerate medical research, improve treatments, and enhance patients' medical outcomes. Artificial intelligence, big data, deep learning and the Internet of things have become key elements play a key role in hospitals' telemedicine initiatives. Thanks to technology, some hospitals become "smart organizations" where data and technological platforms determine the organization's internal processes as well as healthcare professionals' and patients' behaviours. Information and communication technologies contribute to accelerate hospitals' digital transformation and develop new communication projects focused on health education. Thanks to these projects, hospitals promote their brand and improve their relations with stakeholders: employees, patients, public authorities, media companies and patients' associations.

This paper aims to analyze how smart hospitals manage mobile applications to improve their relations with stakeholders and this way reinforce their brands. To do that, we conducted a literature review about how these organizations manage technology to accelerate their digital transformation (artificial intelligence, big data, deep learning, internet of things, health 4.0, telemedicine); then, we analyzed how these hospitals implement branding strategies (hospital's brand, meaningful content, role of humanities); and finally, we evaluated the role of mobile apps in these organizations' branding strategies (corporate credibility, doctors' mobile literacy, patients' empowerment). Based on this literature review, we defined 36 branding indicators, and we used them to carry out a quantitative analysis about how the 300 best smart hospitals in the world managed mobile apps to promote health education, improve their relations with stakeholders, and reinforce their brands. To do that, we resorted to the *World's Best Smart Hospitals 2023*, an annual ranking developed by *Newsweek* and *Statista*. Based on to these quantitative and qualitative inputs, we presented and discussed our results, and we proposed practical recommendations for hospitals.

2. Building Hospital Brands through Mobile Apps

2.1 Smart Hospitals and ICT-mediated Healthcare

Hospitals resort to ICT-mediated initiatives, such as artificial intelligence, big data, deep learning and the Internet of things, to promote Health 4.0 and improve patients' medical outcomes (Bassan, 2020). Thanks to artificial intelligence, hospitals make their healthcare systems more innovative (Lv & Qiao, 2020), enhance medical treatments (Shilo, Rossman & Segal, 2020) and promote collective making-decision processes among patients and healthcare professionals (Manrique de Lara & Peláez-Ballestas, 2020). Artificial intelligence-based healthcare initiatives are especially important for chronic patients: this technology enables patients to perform tasks traditionally carried out by healthcare professionals in a more convenient way, at lower costs, and without compromising quality (Hager *et al.*, 2021). On the other hand, artificial intelligence methods are crucial for medical imaging: in this area, the application of computer vision techniques, traditional machine learning and deep neural networks have achieved remarkable successes (Kaissis *et al.*, 2020). Finally, hospitals use artificial intelligence tools for administration tasks: managing online appointments with patients, recording data for diagnosis, etc. (Dhagarra, Goswami & Kumar, 2020).

Despite these advantages, the legal and ethical requirements are limiting the broad application of artificial intelligence in hospitals (Kaissis *et al.*, 2020). These organizations must implement professional practices and train their employees in this area to avoid legal issues and reduce safety risks (Rickert,

2020). Hospitals should use this technology for medical treatments and research projects, but not to promote their commercial interests (Lin & Hou, 2020). On the other hand, these organizations need to collaborate with public health authorities and patients' associations to develop artificial intelligence in an integrated way (Hager *et al.*, 2021), and implement professional practices that respect patients' rights, legal frameworks, ethical principles and public health authorities' requirements (Zegers *et al.*, 2021). This approach is essential to integrate artificial intelligence-based technologies into hospitals' internal protocols and accelerate these institutions' digital transformation (Lin & Hou, 2020).

Along with artificial intelligence tools, hospitals resort to big data to make their internal processes more efficient and this way improve patients' medical outcomes (Shi *et al.*, 2020). Health-related big data initiatives are based on the acquisition of large amounts of information from multiple sources, which is subsequently combined by using data analytics tools (Ferretti *et al.*, 2020). Thanks to this information, doctors take better medical decisions, improve treatments and create data science platforms about diseases, treatments and patients (Mori *et al.*, 2020). On the other hand, when hospitals combine big data with deep learning and the Internet of things-, they can target more efficiently various diseases like pneumonia, sleep apnea or heart related diseases (Boulemtafes, Derhab & Challal, 2022). Besides, they can also develop wearables helping patients to collect information about their physical, behavioral and psychological health (Li *et al.*, 2021). Finally, these organizations must address some legal issues related to these technologies: unauthorized access, errors, secondary use of medical information, etc. (Tseng *et al.*, 2020).

Thanks to artificial intelligence, big data, deep learning and the Internet of things, hospitals promote Health 4.0 in a more efficient way and become smart organizations where data and technology contribute to reduce the risk associated with medical decisions (Al-Jaroodi, Nader & Abukhousa, 2020). One of the main initiatives implemented by smart hospitals is telemedicine, a technological platform that enables remote access to healthcare services and that facilitates mutual interactions among doctors and patients (Mahmoud *et al.*, 2022). Thanks to telemedicine, healthcare professionals establish new relationships with patients based on trust, respect and data (Bassan, 2020), which positively influences patients' perceptions about the hospital, its employees and medical services (Nittari *et al.*, 2022). Hospitals need to adopt a global approach to efficiently integrate telemedicine, artificial intelligence, big data, deep learning, the Internet of things and Health 4.0 into their medical protocols (Ye, 2020).

2.2 Smart Hospitals' Branding Strategies

Building a reputed brand constitutes a priority for hospitals interested in reinforcing their strategic positionings in the healthcare industry (Medina Aguerrebere, Pacanowski & Medina, 2020). Healthcare brands include four main dimensions: brand elements, tangible assets, healthcare professionals' performance, and quality medical services (Odoom, Narteh & Odoom, 2019). When hospitals disseminate content proving their engagement with these four elements, they strengthen their brand credibility (Hart & Phau, 2022), which positively influences stakeholders' perceptions about the hospital (Rahman, Langner & Temme, 2021). To efficiently achieve this objective, this branding content must be consistent with the hospital's corporate initiatives (Govers, 2020). Finally, hospitals resort to quantitative and qualitative indicators to measure their brand performance and evaluate the impact of every communication initiative on the organization's brand (Khosravizadeh *et al.*, 2021).

Hospitals implement integrated branding initiatives and provide stakeholders with meaningful content allowing them to better understand the organization's uniqueness (Gómez-Rico *et al.*, 2022). When developing this content, these organizations respect three main criteria: a) facts proving that the hospital is a unique organization that contributes to enhance society (Reitsamer & Brunner-Sperdin, 2021); b) information describing the hospital's story (Li & Zhao, 2021); and c) content helping stakeholders

improve their skills in health literacy (Lithopoulos *et al.*, 2021). On the other hand, hospitals resort to different platforms to implement branding initiatives: websites, corporate magazines, events and media relations (Govers, 2020). These organizations always try to innovate and use new methods such as corporate social responsibility, to align the hospital's brand with awareness of particular social issues (Correa *et al.*, 2021); or online communities, to allow patients and doctors to share medical information and personal experiences (Chen & Wang, 2021).

To efficiently implement branding initiatives, hospitals need to integrate humanities and social values into their corporate communication strategies (Li & Xu, 2020). Values such as scientific knowledge, respect and empathy are more important than key performance indicators (Shafiee, Ansari & Mahjob, 2022) because the first ones allow hospitals to establish long-term relationships with stakeholders, especially with patients (Tan *et al.*, 2020). For this reason, many hospitals' Communication Directors employ in their departments several experts in sociology, anthropology and education (Troiseufs, 2020). Thank to this social approach, hospitals can focus their branding initiatives on health education, patients' rights, and public engagements (Suárez-Argüello *et al.*, 2021).

2.3 Branding Smart Hospitals through Mobile Apps

Mobile apps can be defined as software applications developed by companies and used by consumers in different devices, such as smartphones and tablets (Ragavan, Ferre & Bair-Merritt, 2020). Thanks to mobile applications, consumers improve their experiences and companies accelerate their internal and external processes (Mateus-Coelho & Avila, 2021). These applications can be grouped into different categories: information retrieval, contact management, education, eBooks, business, lifestyle, social media, productivity, entertainment and games (Yu *et al.*, 2021). In the healthcare industry, companies use these applications for different purposes such as supporting clinical diagnosis, reinforcing decision-making processes, improving clinical outcomes, enhancing patients' adherence to treatments, and delivering health education (Rowland *et al.*, 2020). Recently, some hospitals started using mobile apps to improve their surgical processes and make patients' experiences safer (Bahadori, Wainwright & Ahmed, 2018).

Mobile applications are changing the way healthcare knowledge is delivered (Mateus-Coelho & Avila, 2021). Hospitals resort to these platforms to share accurate information with different stakeholders and this way improve their scientific credibility (Palacios-Gálvez *et al.*, 2021). These organizations also use mobile apps for corporate communication purposes. To efficiently do that, hospitals must consider their stakeholders' skills in mobile literacy (Van der Kruk *et al.*, 2022), and implement communication initiatives adapted to their stakeholders' needs in terms of information and emotional support (Merminod & Benaroyo, 2021). When hospitals manage mobile applications in this way, they reinforce their scientific credibility (Jenkins *et al.*, 2020), establish trust relationships with stakeholders (Singla & Sharma, 2021) and become social institutions, which positively influences their brands (Reitsamer & Brunner-Sperdin, 2021).

Despite these benefits, the rapid increase in available mobile data is becoming a problem for doctors and nurses since they cannot fully survey this information when taking medical decisions (Oxholm, Christensen & Nielsen, 2022). Healthcare professionals' skills in mobile literacy are essential to protect patients' rights and accelerate hospitals' digital transformation (Yu *et al.*, 2021), that is why many hospitals train their doctors and nurses on how to use these mobile applications for medical purposes (Navarro Martínez, Igual García & Traver Salcedo, 2021). When healthcare professionals use these applications in an appropriate way, they can establish collective making-decision processes along with patients, promote health education, and improve patients' medical outcomes (Rowland *et al.*, 2020). On the other hand, hospitals can also use mobile apps to help healthcare professionals become brand

ambassadors able to establish rich relationships with patients (Medina Aguerrebere, Pacanowski & Medina, 2020), and this way make the organization's brand more dynamic and credible (Tangari *et al.*, 2021).

Healthcare professionals are not the only ones who must reinforce their skills in mobile literacy. Patients should do the same and learn how to use mobile applications to interact with doctors, search medical information, and share experiences with other patients (Dang *et al.*, 2021). Thanks to these applications, patients reinforce their empowerment, protect their rights, and improve their medical results (Luo *et al.*, 2020). These applications are especially important for patients facing serious diseases, such as cancer or heart diseases. Cancer patients' main information needs are related to treatments, personal issues, family concerns and social interactions (Lavdaniti, 2020). According to Turkdogan *et al.*, (2021), using mobile apps can help hospitals fulfill cancer patients' needs. With respect to patients facing heart diseases, their interactions with doctors are directly affected by a complex array of linguistic, interpersonal, sociocultural, and emotional issues (Mentru *et al.*, 2020); and these aspects could be mitigated when hospitals propose patient-centered mobile apps (Świątoniowska-Lonc *et al.*, 2020).

3 Methodology

Most hospitals resort to artificial intelligence, big data, deep learning, the Internet of things, telemedicine, Health 4.0 and mobile apps to enhance their internal processes and improve patients' medical outcomes. Thanks to these technologies, hospitals implement health education initiatives allowing patients to reinforce their empowerment, which positively influences on these organizations' brand reputation. In order to better understand how hospitals manage this technology for health education and branding purposes, we resorted to the *World's Best Smart Hospitals 2023*, an annual ranking developed by *Newsweek* and *Statista*. This ranking awards the best 300 hospitals in the field of smart technologies. Its methodology is based on three main steps. First, an international survey to 4.000 hospital managers and health professionals who recommended the best smart hospitals across the globe, considering five main categories: electronic functionalities, telemedicine, digital imaging, artificial intelligence and robotics. Second, an international survey about how the hospitals previously selected implement and manage digital technologies, focusing especially on the five categories already mentioned. And third, desk research to review every nominated hospital's achievements in technical innovation and smart technologies. Based on this information, a score was calculated for each hospital. These results were validated by experts working for leading hospitals in the United States, Switzerland, Germany and Israel.¹

Thanks to this ranking, we identified the 300 best smart hospitals in the world (see *Appendix 1*). We analyzed each hospital's online presence (corporate website, patient portal, social media platforms), and we mainly focused on how these organizations managed mobile apps for health education and branding purposes. We considered these four technological tools because corporate websites play a key role in hospitals' health education initiatives (Li *et al.*, 2021); patient portals allow these organizations to reinforce patients' empowerment (Driever, Stiggelbout & Brand, 2019); and social media platforms have become essential tools for hospitals interested in building their brands in a collective way along with stakeholders (Kumar *et al.*, 2020). We mainly focused on mobile apps because these applications allow hospitals to enhance their health education initiatives (Rowland *et al.*, 2020) and establish better relationships with stakeholders, especially with patients (Palacios-Gálvez *et al.*, 2021). Finally, we analyzed

1. Information retrieved on 3rd December 2022 from: <https://www.newsweek.com/rankings/worlds-best-smart-hospitals-2023>

mobile apps for patients suffering from noncommunicable diseases (NDS) because it represents 74% of all deaths globally (World Health Organization, 2022). We prioritized the two most prevalent NDSs: cancer and cardiovascular diseases.

From 6th December 2022 to 10th January 2023, we conducted a quantitative analysis to better understand how the 300 best smart hospitals in the world managed mobile apps for health education and branding purposes. Based on our literature review, we defined 36 indicators that we grouped into four categories: a) online integration, b) global app for patients, c) mobile apps for other targets, and d) mobile apps for patients facing noncommunicable diseases (see *Table 1*). We only considered official mobile apps developed by hospitals, as well as mobile apps designed by external providers that were adapted to the hospital's medical system. On the other hand, we mainly focused on mobile apps addressed to patients. Lastly, we used the binary system to analyze all indicators, except one that was evaluated as an absolute number: online integration (5. *Number of mobile apps*). For each hospital, we analyzed its website, the links available to the hospital's patient portal, as well as the links leading to the organization's official profiles on social media platforms. Concerning mobile apps, we resorted to the hospital's website, as well as to the *App Store* and the *Google Play Store*, to check how many mobile apps each hospital proposed to patients as well as to other stakeholders. Once identified all mobile apps, we downloaded each of them on our tablets to analyze its main characteristics and functionalities.

Table 1. Indicators

Online integration	Global app for patients	Mobile apps for other targets	Mobile apps for patients facing noncommunicable diseases	
			Cancer	Cardiovascular diseases
<ol style="list-style-type: none"> 1. Corporate website 2. Patient portal 3. Social media platforms 4. Mobile apps 5. Number of mobile apps 	<ol style="list-style-type: none"> 1. Review test results 2. Upload personal data 3. Access family's health data 4. Communicate with doctors 5. Manage appointments 6. Request prescriptions 7. Conduct video consultations 8. Find physicians 9. Pay bills 	<ol style="list-style-type: none"> 1. Patients facing particular diseases 2. Employees 3. Suppliers 4. Media companies 	<ol style="list-style-type: none"> 1. Read health education information 2. Track medical metrics 3. Contact doctors 4. Conduct online consultations 5. Request prescriptions 6. Review test results 7. Upload personal data 8. Manage appointments 9. Find physicians 	<ol style="list-style-type: none"> 1. Read health education information 2. Track medical metrics 3. Contact doctors 4. Conduct online consultations 5. Request prescriptions 6. Review test results 7. Upload personal data 8. Manage appointments 9. Find physicians

Source: Authors.

4 Results

Our quantitative results proved that most hospitals used websites, patient portals, social media platforms and mobile apps to implement health education initiatives whose main objective was to improve the organization's relations with stakeholders. However, most hospitals can still improve in this area, especially when it comes to how they use mobile apps for health education and branding purposes. To justify this sentence, we present our results grouped in four main categories: 1) online integration, 2) global mobile app, 3) mobile apps for other targets, and 4) mobile apps for patients facing noncommunicable diseases.

Online integration. According to our analysis, most hospitals managed corporate websites (99%), social media platforms (91,7%), patient portals (63,7%) and mobile apps (57%). On average, these organizations proposed 2,6 mobile apps to their different stakeholders. The best hospital by number of mobile apps was *Cleveland Clinic* (see *Table 2*).

Table 2. Best hospitals by number of mobile apps

Hospital	Number of mobile apps
<i>Cleveland Clinic, Cleveland Clinic - Florida, Cleveland Clinic Fairview Hospital (United States) (1)</i>	14
<i>Ronald Reagan UCLA Medical Center (United States)</i>	11
<i>Hôpitaux Universitaires de Genève (Switzerland)</i>	10
<i>Intermountain Medical Center (United States)</i>	10
<i>The Johns Hopkins Hospital, Johns Hopkins Bayview Medical Center (United States) (2)</i>	9
<i>Children's Hospital of Philadelphia (United States)</i>	9
<i>Foothills Medical Centre (Canada)</i>	7
<i>Vanderbilt University Medical Center (United States)</i>	7
<i>Massachusetts General Hospital (United States)</i>	7

(1) All hospitals belong to the same group and use the same mobile apps

(2) All hospitals belong to the same group and use the same mobile apps

Global mobile app. Our analysis demonstrated that 82% of hospitals having mobile apps displayed a global mobile application allowing patients to carry out different activities: review test results (99,3%), upload personal health data (98,6%), manage appointments (96,4%), communicate with doctors (82,6%), pay bills (62,6%), find physicians (59,3%), request prescriptions (50,7%), access family's health information (33,6%), and conduct video consultations with doctors (25%). On the other hand, 79,3% of hospitals having a global mobile app respected between 5 and 7 indicators. The only hospitals fulfilling the 9 indicators were *Baylor University Medical Center* and *Baylor Scott & White Medical Center -United States-* (see *Table 3*). Finally, many hospitals having global mobile apps resorted to external developers that created these apps, and then, they adapted these applications to the hospital's internal system.²

2. Some hospitals used a general mobile app fully developed by an external organization that they adapted subsequently to the hospital's medical system.

a) My Chart (EPIC): United States (*Johns Hopkins All Children's Hospital, Mount Sinai Medical Center, Brigham And Women's Hospital, Brigham And Women's Faulkner Hospital, MD Anderson Cancer Center, Boston Medical Center, UCLA Medical Center - Santa Monica, UCSF Medical Center, Barnes-Jewish Hospital, Jefferson Health - Thomas Jefferson University Hospitals, University of Chicago Medical Center, Baylor St. Luke's Medical Center, Hurley Medical Center, Children's Hospital of Philadelphia, UC San Diego Health - Jacobs Medical Center, Geisinger Wyoming Valley Medical Center, Geisinger Medical Center, University of Utah Hospital, UT Southwestern Medical Center, University of Wisconsin Hospitals, Bellevue Hospital Center, Seattle Children's Hospital, University of Kansas Hospital, Texas Children's Hospital, Morristown Medical Center, Tampa General Hospital, Bon Secours DePaul Medical Center, Cincinnati Children's Hospital Medical Center, and OHSU Hospital*). Canada (*The Ottawa Hospital, Mackenzie Richmond Hill Hospital, St. Michael's Hospital, Cortellucci Vaughan Hospital, and Hospital for Sick Children*). United Kingdom (*University College Hospital, Addenbrooke's, National Hospital For Neurology and Neurosurgery - Queen Square, and Great Ormond Street Hospital*).

b) Health Buddy (SignHealth Group): Singapore (*Changi General Hospital, Singapore General Hospital, and KK Women's And Children's Hospital*).

c) MinSP (Region Hovedstaden): Denmark (*Hvidovre Hospital, and Herlev Hospital*).

Table 3. Best apps by number of indicators

Mobile apps and Hospital (s)	Indicators (out of 9)
My BSW Health App (<i>Baylor University Medical Center, Baylor Scott & White Medical Center, United States</i>)	9
My Mount Sinai App (<i>The Mount Sinai Hospital, Mount Sinai Morningside, United States</i>)	8
My HSS App (<i>Hospital For Special Surgery, United States</i>)	8
My UofM Health App (<i>University of Michigan Hospitals - Michigan Medicine, United States</i>)	8
Pine App (<i>Baptist Hospital of Miami, United States</i>)	8
My Mercy App (<i>Mercy Hospital St. Louis, United States</i>)	8
OneNUHS App (<i>National University Hospital, Singapore</i>)	8
Ask Apollo App (<i>Apollo Hospital – Chennai, India</i>)	8
Programa My-Hospital App (<i>Policlinico Universitario Campus Bio-Medico, Italy</i>)	8
My Path App (<i>Helsinki University Hospital, Finland</i>)	8

Mobile apps for other targets. Most hospitals proposing mobile apps focused on patients facing particular diseases (33,3%) as well as on the organization's employees (32,7%), but not on external media companies (2,3%) or on the hospital's suppliers (0%). No hospital proposed at least one mobile app for these four targets, and the only one displaying at least one app for three targets was *Cleveland Clinic* (Cleveland, Florida, Fairview): employees (*Bariatric Surgery Calculator App*), media companies (*Cleveland Clinic CME App*) and patients facing particular diseases (*Sleep by Cleveland Clinic App*).

Apps for patients facing noncommunicable diseases. According to our data, only 5,3% of hospitals having mobile apps proposed at least one app for patients facing cancer. Thanks to these apps, these patients could access health education information (100%), manage appointments (100%), find physicians (88,9%), contact doctors (66,7%), upload personal health data (66,7%), track different metrics (33,3%), review test results (33,3%), and conduct online consultations with doctors (11,10%). However, no app enabled patients to request prescriptions. The best mobile app for these patients was the one developed by *Memorial Sloan Kettering Cancer Center -United States-* (see *Table 4*).

Concerning patients suffering from cardiovascular diseases, only 5,85 % of hospitals having mobile apps showcased at least one app for these patients. These apps allowed them to access health education information (100%), contact doctors (100%), upload personal health data (100%), find physicians (100%), track different metrics (40%), review test results (20%) and manage appointments (20%). Nevertheless, no hospital had an app enabling these patients to conduct online consultations with doctors or to request prescriptions. *IC App*, developed by *Hôpitaux Universitaires de Genève* (Switzerland), was the only one to respect at least 7 indicators (see *Table 5*).

Table 4. Best apps for cancer patients

Mobile apps and Hospital(s)	Number of indicators
Cancer Distress Coach (<i>Memorial Sloan Kettering Cancer Center, United States</i>)	7
Cancer du sein App (<i>Hôpitaux Universitaires de Genève, Switzerland</i>)	7
UM Skin Check App (<i>University of Michigan Hospitals - Michigan Medicine, United States</i>)	7
UPMC Hillman Trials Finder (<i>UPMC Presbyterian & Shadyside, UPMC Children's Hospital of Pittsburgh, United States</i>)	5
UCSF Fetal Treatment Center (<i>UCSF Medical Center, United States</i>)	5
VeloSano App (<i>Cleveland Clinic, Cleveland Clinic – Florida, Cleveland Clinic Fairview Hospital, United States</i>)	3

Table 5. Best apps for cardiovascular patients

Mobile apps and Hospital(s)	Number of indicators
IC App (<i>Hôpitaux Universitaires de Genève, Switzerland</i>)	7
My Monzino App (<i>Centro Cardiologico Monzino, Italy</i>)	6
Hearts of Athletes App (<i>Duke University Hospital, Duke Regional Hospital, United States</i>)	5
MyHeart CHOP App (<i>Children's Hospital of Philadelphia, United States</i>)	5
Mayo Clinic Cardiovascular CME App (<i>Mayo Clinic – Rochester, Mayo Clinic – Phoenix, Mayo Clinic – Jacksonville, Mayo Clinic - Health System In Eau Claire, United States</i>)	4
Vanderbilt Heart and Vascular App (<i>Vanderbilt University Medical Center, United States</i>)	4

5 Discussion

Promoting organizations' brand authenticity constitutes a challenge because stakeholders need tangible inputs to believe in companies' corporate messages (Rahman, Langner & Temme, 2021). When companies share data and facts proving that they respect their original roots (Rindell & Santos, 2021) and integrate client's needs into the company's branding initiatives, these companies become genuine brands (Sander *et al.*, 2021). Stakeholders trust these companies because they express their corporate intentions without hiding anything and exhibit purity of character (Hart & Phau, 2022). According to our results, most smart hospitals try to become genuine brands because they manage different technological tools for medical reasons, but also for branding purposes: in fact, most of these organizations resorted to websites (99%), social media platforms (91,7%), patient portals (63,7%) and mobile apps (57%) to reinforce their relations with stakeholders and this way promote their brand authenticity.

To efficiently promote this value, more and more hospitals use different kinds of mobile apps (Piculell *et al.*, 2021). Thanks to these applications, hospitals reinforce patients' skills in health education

(Chamberlain *et al.*, 2021), which contributes to improve patient's medical outcomes (Crossley *et al.*, 2020) and reinforce hospitals' brand (Mackert *et al.*, 2020). However, our results proved that 43% of smart hospitals did not propose mobile apps to their stakeholders. And, on the other hand, most hospitals having mobile apps did not use these applications to reinforce their relations with employees (67,3%) or with external media companies (97,7%). In other words, our analysis demonstrated that most smart hospitals resorted to mobile apps for improving medical and administrative tasks (manage appointments, paying bills, etc.), but not for implementing branding and health education initiatives.

Mobile apps, artificial intelligence, big data, deep learning, the Internet of things and telemedicine play a key role in hospitals' digital transformation, but also in these organizations' reputation (Lin & Hou, 2020). Hospitals should use this technology for medical purposes, but also to reinforce their engagements with stakeholders (Zhao, 2020; Triemstra, Poepelman & Arora, 2018) and this way promote the organization's reputation (Lithopoulos *et al.*, 2021). Nevertheless, our results proved that most hospitals did not propose mobile apps to patients facing serious health problems, such as the noncommunicable diseases. In fact, only 5,3% of hospitals having mobile apps had at least one application for patients facing cancer, and only 5,85% showcased mobile applications for patients suffering from cardiovascular diseases. In other words, most smart hospitals did not consider these patients' information and communication needs, which constitutes a reputation risk for these companies. Finally, concerning the global app proposed to patients, many hospitals resorted to external developers (*SignHealth Group, Epic, etc.*) and proposed similar services, which makes it difficult for these organization to build a unique brand.

Promoting hospitals' brand through mobile apps constitutes a challenge, as well as an opportunity to accelerate these organizations' digital transformation. This paper aimed to better understand how the world's best smart hospitals managed mobile applications to promote health education and reinforce their brands. Thanks to our quantitative analysis, we identified some interesting facts that will help these organizations to improve their branding initiatives. However, we must highlight three main limitations affecting our research. First, we did not contact every hospital's corporate communication department, which avoided us to understand how they integrated mobile apps into the organization's branding initiatives. Second, we did not consider legal and ethical frameworks affecting hospitals in each country, which highly determines these organizations' investments in mobile applications. And third, we did not find other papers analyzing the same topic and focusing on the same organizations, which made it impossible for us to compare our quantitative results. In the next years, researchers interested in developing this area should focus on different issues such as how to train doctors to use mobile apps for branding purposes, how to integrate these applications into the hospital's branding strategies, and how to use these applications to help patients become brand ambassadors.

6 Conclusion

Most smart hospitals resort to information and communication technologies to improve their internal processes, enhance medical treatments and establish better relationships with stakeholders, especially with patients. Artificial intelligence, big data, deep learning, the Internet of things, health 4.0 and telemedicine have become strategic areas for these organizations. Thanks to this technology, hospitals accelerate their digital transformation and influence their stakeholders' perceptions about the hospital brand. This paper aimed to analyze how smart hospitals manage mobile applications to improve their relations with stakeholders and this way reinforce the organization's brand. To conclude, we would like to highlight three last ideas. First, most hospitals followed an administration logic rather than a health education and branding approach, that is why most of them used their global mobile apps to propose different services such as reviewing medical results (99,3%) or managing appointments (96,4%), and only 25% of them allowed patients to use these apps to conduct video consultations with doctors, ask

questions and interact with the organization's employees. Using mobile apps in a professional way could help hospitals to establish a new communication paradigm where technology, health education and patients' rights become key elements of these organizations' branding initiatives. Second, many hospitals did not use mobile apps to interact with different stakeholders at the same time, which avoided them to build the brand in a collective way: in fact, only 32,7% of hospitals proposed an app for their employees, and only 2,3% had an app for external media companies. Hospitals need to develop creative ways to integrate stakeholders into the organization's brand building processes: mobile apps can contribute to make hospitals' branding processes more democratic and dynamic. And third, most hospitals did not use their mobile apps to disseminate corporate content (hospital's identity, main values, mission). This situation constitutes a reputation threat that can lead hospitals to face economic losses. Using mobile apps to explain why the hospital's brand architecture is unique contributes to reinforce these organizations' strategic positioning in the healthcare industry.

Based on these conclusions, we recommend hospitals three main ideas to efficiently manage mobile apps as branding tools. First, these organizations need to implement a Mobile Apps Unit where experts in artificial intelligence, public health and corporate communication work together to develop meaningful contents that fulfill the hospital's requirements as well the stakeholders' needs in terms of information and emotional support. Second, this business unit must help the hospital to integrate mobile apps into the organization's medical protocols, train healthcare professionals on how to manage this technology for medical and branding purposes and help stakeholders to efficiently use these applications when interacting with the organization. Finally, the Mobile Apps Unit should analyze the data gathered through these applications, and based on that, update the services proposed to stakeholders. This way, hospitals can provide stakeholders with meaningful content that positively influences their perceptions about the hospital's brand.

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Appendix 1. World's Best Smart Hospitals

1. Mayo Clinic - Rochester (United States)
2. Massachusetts General Hospital (United States)
3. The Johns Hopkins Hospital (United States)
4. Cleveland Clinic (United States)
5. The Mount Sinai Hospital (United States)

6. Brigham And Women's Hospital (United States)
7. MD Anderson Cancer Center (United States)
8. Memorial Sloan Kettering Cancer Center (United States)
9. Karolinska Universitetssjukhuset (Sweden)
10. Houston Methodist Hospital (United States)
11. Charité - Universitätsmedizin Berlin (Germany)
12. Cedars-Sinai Medical Center (United States)
13. Sheba Medical Center (Israel)
14. New York-Presbyterian Hospital-Columbia and Cornell (United States)
15. Abbott Northwestern Hospital (United States)
16. Aarhus Universitetshospital (Denmark)
17. Boston Medical Center (United States)
18. Beth Israel Deaconess Medical Center (United States)
19. AP-HP - Hôpital Européen Georges Pompidou (France)
20. Universitätsklinikum Essen (Germany)
21. Stanford Health Care - Stanford Hospital (United States)
22. Aalborg Universitetshospital (Denmark)
23. Institut Gustave Roussy (France)
24. UCLA Medical Center - Santa Monica (United States)
25. Saratoga Hospital (United States)
26. Mayo Clinic - Phoenix (United States)
27. AP-HP - Hôpital Universitaire Pitié Salpêtrière (France)
28. Mount Sinai Morningside (United States)
29. Fortis Memorial Research Institute (India)
30. Samsung Medical Center (South Korea)
31. Tan Tock Seng Hospital (Singapore)
32. Ronald Reagan UCLA Medical Center (United States)
33. Istituto Clinico Humanitas (Italy)
34. Changi General Hospital (Singapore)
35. Oslo Universitetssykehus (Norway)
36. The University of Tokyo Hospital (Japan)
37. UCSF Medical Center (United States)
38. Hospital Universitari Vall d'Hebron (Spain)
39. St. Olavs Hospital (Norway)
40. Hospital Israelita Albert Einstein (Brazil)
41. Gleneagles Hospital (Singapore)
42. Helsinki University Hospital (Finland)
43. Mayo Clinic - Jacksonville (United States)
44. Barnes-Jewish Hospital (United States)
45. Hospital For Special Surgery (United States)
46. Universitätsspital Zürich (Switzerland)
47. Brigham And Women's Faulkner Hospital (United States)
48. Akademiska Sjukhuset (Sweden)
49. Hospital of the University of Pennsylvania - Penn Presbyterian (United States)
50. Erasmus Medisch Centrum (The Netherlands)
51. Jefferson Health - Thomas Jefferson University Hospitals (United States)
52. Kyoto University Hospital (Japan)
53. Boston Children's Hospital (United States)
54. Toronto General - University Health Network (Canada)
55. Azienda Ospedaliera San Camillo Forlanini (Italy)

56. University of Chicago Medical Center (United States)
57. Duke University Hospital (United States)
58. Seoul National University Hospital (South Korea)
59. Asan Medical Center (South Korea)
60. Mount Sinai Medical Center (United States)
61. Centre Hospitalier de l'Université de Montréal (Canada)
62. Ospedale Pediatrico Bambino Gesù di Roma (Italy)
63. Ospedale San Raffaele - Gruppo San Donato (Italy)
64. Nagoya University Hospital (Japan)
65. Hospital Clínic de Barcelona (Spain)
66. Hospital General Universitario Gregorio Marañón (Spain)
67. Universitätsklinikum Düsseldorf (Germany)
68. St Thomas' Hospital (United Kingdom)
69. Lucile Salter Packard Children's Hospital (United States)
70. Children's Medical Center Dallas (United States)
71. Centre Hospitalier Universitaire Vaudois (Switzerland)
72. NYU Langone Hospitals (United States)
73. Johns Hopkins Bayview Medical Center (United States)
74. The Ottawa Hospital (Canada)
75. Singapore General Hospital (Singapore)
76. Guy's Hospital (United Kingdom)
77. Clemenceau Medical Center (Lebanon)
78. Hospital Sirio Libanes (Brazil)
79. University College Hospital (United Kingdom)
80. AP-HP - Hôpital Saint-Louis (France)
81. Policlinico Universitario A. Gemelli (Italy)
82. Hospital Universitario La Paz (Spain)
83. Klinikum Rechts der Isar der Technischen Universität München (Germany)
84. North York General Hospital (Canada)
85. Royal Brompton Hospital (United Kingdom)
86. Hospital Universitario 12 de Octubre (Spain)
87. Apollo Hospital - Chennai (India)
88. Mount Sinai Hospital (Canada)
89. Academisch Ziekenhuis Maastricht (The Netherlands)
90. Tel-Aviv Sourasky Medical Center (Israel)
91. Keio University Hospital (Japan)
92. Universitätsklinikum Heidelberg (Germany)
93. Universitätsklinikum Hamburg-Eppendorf (Germany)
94. Yale New Haven Hospital (United States)
95. Ospedale Casa Sollievo della Sofferenza (Italy)
96. Cleveland Clinic Abu Dhabi (United Arab Emirates)
97. Amsterdam UMC (The Netherlands)
98. Wooridul Spine Hospital (South Korea)
99. Allgemeines Krankenhaus der Stadt Wien - Medizinischer Universitätscampus (Austria)
100. Gangnam Severance Hospital - Yonsei University (South Korea)
101. Humber River Hospital (Canada)
102. Emory University Hospital (United States)
103. VCH - Vancouver General Hospital (Canada)
104. Kameda Medical Center (Japan)
105. Inselspital Bern (Switzerland)

106. Moorfields Eye Hospital (United Kingdom)
107. Baylor St. Luke's Medical Center (United States)
108. UMC Utrecht (The Netherlands)
109. Adventhealth Orlando (United States)
110. Seoul National University - Bundang Hospital (South Korea)
111. University of Michigan Hospitals - Michigan Medicine (United States)
112. Charing Cross Hospital (United Kingdom)
113. Addenbrooke's (United Kingdom)
114. Mayo Clinic - Health System In Eau Claire (United States)
115. Hurley Medical Center (United States)
116. UZ Leuven - Campus Gasthuisberg (Belgium)
117. Mackenzie Richmond Hill Hospital (Canada)
118. Children's Hospital of Philadelphia (United States)
119. Cambridge Medical Center (United States)
120. Great Ormond Street Hospital (United Kingdom)
121. Royal Melbourne Hospital (Australia)
122. UPMC Presbyterian & Shadyside (United States)
123. Vanderbilt University Medical Center (United States)
124. Rigshospitalet - København (Denmark)
125. Peter MacCallum Cancer Centre (Australia)
126. Istituto Giannina Gaslini (Italy)
127. Agaplesion Diakonieklinikum Hamburg (Germany)
128. Cleveland Clinic - Florida (United States)
129. CHU Lille - Hôpital Claude-Huriez (France)
130. Dignity Health - California Hospital Medical Center (United States)
131. Tampere University Hospital (Finland)
132. LMU Klinikum (Germany)
133. Universitätsklinikum Schleswig-Holstein - Campus Kiel (Germany)
134. UC San Diego Health - Jacobs Medical Center (United States)
135. Clinica Universidad de Navarra (Spain)
136. Baptist Hospital of Miami (United States)
137. Duke Regional Hospital (United States)
138. CHU Strasbourg - Hôpital Civil (France)
139. Royal Free Hospital (United Kingdom)
140. Geisinger Wyoming Valley Medical Center (United States)
141. Baycrest Centre (Canada)
142. Northwestern Memorial Hospital (United States)
143. University of Utah Hospital (United States)
144. Deutsches Herzzentrum Berlin (Germany)
145. Hospices Civils de Lyon - Hôpital Lyon Sud (France)
146. UT Southwestern Medical Center (United States)
147. Akershus Universitetssykehus (Norway)
148. Baylor Scott & White Medical Center (United States)
149. Bumrungrad International Hospital (Thailand)
150. Rush University Medical Center (United States)
151. CHU Bordeaux - Groupe Hospitalier Pellegrin (France)
152. Osaka University Hospital (Japan)
153. AP-HP - Hôpital Henri-Mondor (France)
154. Universitätsklinikum Bonn (Germany)
155. Universitätsklinikum Tübingen (Germany)
156. University of Washington Medical Center (United States)

157. King's College Hospital (United Kingdom)
158. Cliniques universitaires Saint-Luc (Belgium)
159. Geisinger Medical Center (United States)
160. University of Wisconsin Hospitals (United States)
161. Hôpitaux Universitaires de Genève (Switzerland)
162. Juntendo University Hospital (Japan)
163. Mercy Harvard Hospital (United States)
164. Policlinico Universitario Campus Bio-Medico (Italy)
165. ULB - Hôpital Erasme (Belgium)
166. CHU Nantes - Site Hôtel-Dieu (France)
167. AP-HM - Hôpital de la Timone (France)
168. Severance Hospital - Yonsei University (South Korea)
169. University Hospitals Cleveland Medical Center (United States)
170. Medizinische Hochschule Hannover (Germany)
171. Linz Kepler Universitätsklinikum (Austria)
172. Cleveland Clinic Fairview Hospital (United States)
173. Universitätsklinikum Mannheim (Germany)
174. Hospital Clínico San Carlos (Spain)
175. KK Women's And Children's Hospital (Singapore)
176. CHU Montpellier - Hôpital Lapeyronie (France)
177. Bellevue Hospital Center (United States)
178. National University Hospital (Singapore)
179. AP-HP - Hôpital Bichat-Claude-Bernard (France)
180. Korea University - Anam Hospital (South Korea)
181. Luzerner Kantonsspital (Switzerland)
182. Hadassah Ein Kerem Hospital (Israel)
183. Universitätsklinikum Carl Gustav Carus Dresden (Germany)
184. BP – A Beneficência Portuguesa de São Paulo (Brazil)
185. BG-Unfallklinik - Unfallkrankenhaus Berlin (Germany)
186. Agaplesion Markus Krankenhaus (Germany)
187. Mount Elizabeth Hospital - Novena (Singapore)
188. California Pacific Medical Center (United States)
189. King Abdulaziz Medical City (Saudi Arabia)
190. Seattle Children's Hospital (United States)
191. Hanyang University Medical Center (South Korea)
192. Hôpital Américain (France)
193. Children's Hospital Los Angeles (United States)
194. St. Paul's Hospital (Canada)
195. Claraspital (Switzerland)
196. Royal Prince Alfred Hospital (Australia)
197. Universitätsklinik Balgrist (Switzerland)
198. Herlev Hospital (Denmark)
199. Nebraska Medicine - Nebraska Medical Center (United States)
200. Clinique Internationale Parc Monceau (France)
201. Klinik Hirslanden Zürich (Switzerland)
202. Istituto Europeo di Oncologia (Italy)
203. A.O. Ospedali Riuniti Marche Nord - Presidio San Salvatore Centro (Italy)
204. Japanese Red Cross Medical Center (Japan)
205. St. Michael's Hospital (Canada)
206. Rabin Medical Center (Israel)
207. Toronto East Health Network - Michael Garron Hospital (Canada)

208. Kurashiki Central Hospital (Japan)
209. Schulthess Klinik (Switzerland)
210. Centro Cardiologico Monzino (Italy)
211. John Radcliffe Hospital (United Kingdom)
212. Hospital Samaritano (Brazil)
213. Ajou University Hospital (South Korea)
214. Asklepios Klinik St. Georg (Germany)
215. Päijänne Tavastia Central Hospital (Finland)
216. Clínica Sagrada Família (Spain)
217. Institut Curie (France)
218. Gold Coast University Hospital (Australia)
219. Landeskrankenhaus Universitätskliniken Innsbruck (Austria)
220. University of Kansas Hospital (United States)
221. Chelsea and Westminster Hospital (United Kingdom)
222. Universitätsklinikum Erlangen (Germany)
223. Texas Children's Hospital (United States)
224. Universitätsklinikum Freiburg (Germany)
225. Intermountain Medical Center (United States)
226. University of Maryland Medical Center (United States)
227. Cortellucci Vaughan Hospital (Canada)
228. KyungHee University Medical Center (South Korea)
229. Johns Hopkins All Children's Hospital (United States)
230. Stadspital Zürich Triemli (Switzerland)
231. The Alfred (Australia)
232. Radboud Universitair Medisch Centrum (The Netherlands)
233. Istituto Nazionale dei Tumori (Italy)
234. The Catholic University of Korea - Seoul St. Mary's Hospital (South Korea)
235. Odense Universitetshospital (Denmark)
236. Meyer - Azienda Ospedaliero Universitaria (Italy)
237. UPMC Children's Hospital of Pittsburgh (United States)
238. Nippon Medical School Hospital (Japan)
239. Morristown Medical Center (United States)
240. Keck Hospital of USC (United States)
241. Haukeland Universitetssykehus (Norway)
242. Baylor University Medical Center (United States)
243. Mouwasat Hospital Khobar (Saudi Arabia)
244. St. Bartholomew's Hospital (United Kingdom)
245. Grande Ospedale Metropolitano Niguarda (Italy)
246. Japanese Red Cross Kyoto Daiichi Hospital (Japan)
247. Birmingham Children's Hospital (United Kingdom)
248. Martini-Klinik am UKE (Germany)
249. A.O.U. Città della Salute e della Scienza di Torino (Italy)
250. AZ Maria Middelaers (Belgium)
251. Catharina Ziekenhuis (The Netherlands)
252. Children's Medical Center Plano (United States)
253. OHSU Hospital (United States)
254. Taichung Veterans General Hospital (Taiwan)
255. Bispebjerg Hospital (Denmark)
256. Sørlandet Sykehus Kristiansand (Norway)
257. Jeroen Bosch Ziekenhuis (The Netherlands)

258. Cincinnati Children's Hospital Medical Center (United States)
259. Carolinas Medical Center (United States)
260. Tampa General Hospital (United States)
261. Hospital for Sick Children (Canada)
262. Institut Paoli-Calmettes (France)
263. Bon Secours DePaul Medical Center (United States)
264. Oulu University Hospital (Finland)
265. Hospital Universitario y Politécnico la Fe (Spain)
266. Foothills Medical Centre (Canada)
267. Ospedale Papa Giovanni XXIII (Italy)
268. Benedictus Krankenhaus Feldafing (Germany)
269. Kuopio University Hospital (Finland)
270. Okayama University Hospital (Japan)
271. Royal North Shore Hospital (Australia)
272. St Vincent's Private Hospital - Fitzroy (Australia)
273. Robert-Bosch-Krankenhaus (Germany)
274. Hôpital Paris Saint-Joseph (France)
275. Forsyth Medical Center (United States)
276. National Hospital For Neurology and Neurosurgery - Queen Square (United Kingdom)
277. Ospedale San Martino di Genova (Italy)
278. Rambam Health Care Campus (Israel)
279. Shamir Medical Center (Israel)
280. Memorial Hermann - Texas Medical Center (United States)
281. Bethesda Spital (Switzerland)
282. Provident Hospital of Cook County (United States)
283. Ospedale Morgagni e Pierantoni (Italy)
284. BovenIJ Ziekenhuis (The Netherlands)
285. Centro Médico ABC - Campus Observatorio (Mexico)
286. Hospital de Basurto (Spain)
287. Freeman Hospital (United Kingdom)
288. The Royal London Hospital (United Kingdom)
289. Aichi Medical University Hospital (Japan)
290. Hvidovre Hospital (Denmark)
291. Hospital Pro Matre (Brazil)
292. Hospital Médica Sur (Mexico)
293. Hallym University Kangnam Sacred Heart Hospital (South Korea)
294. The London Independent Hospital (United Kingdom)
295. Hospital Universitario Ramón y Cajal (Spain)
296. Hospital Moinhos de Vento (Brazil)
297. Bristol Royal Infirmary (United Kingdom)
298. Mercy Hospital St. Louis (United States)
299. Nuffield Health Bristol Hospital (United States)
300. Sir Charles Gairdner Hospital (Australia)