

Assessing the Accessibility of Public Healthcare Web Services in Spain

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Abstract—This paper presents a large-scale automated accessibility evaluation of public healthcare web services in Spain. The Spanish healthcare system is decentralized across autonomous regions, which has resulted in the development of multiple digital platforms for citizen interaction. We analyze the impact of such decentralization on the quality of the services provided to healthcare users in critical services like primary care. In this work, we compiled a dataset of 57 official healthcare web services covering all autonomous communities and the cities of Ceuta and Melilla. Automated audits were performed using Google Lighthouse to collect accessibility, performance, and structural metrics. The analysis revealed important variability across both territorial healthcare platforms and service categories. Informational healthcare pages generally obtained the highest accessibility scores, whereas transactional systems exhibited greater variability and lower average accessibility performance.

Keywords—Web Accessibility; eHealth; Public Healthcare Services; Automated Accessibility Evaluation; eGovernment; Healthcare Portals.

I. INTRODUCTION

Digital public services have become a central component of modern eGovernment infrastructures. Healthcare systems rely heavily on online platforms to provide citizens with essential services, such as appointment booking, access to medical information, and interaction with healthcare providers. Ensuring that these services are accessible to all citizens is therefore a critical requirement for public administration. In Spain, the public healthcare system is decentralized across autonomous communities, each responsible for developing and maintaining its own digital health platforms. This organizational structure has resulted in a heterogeneous ecosystem of healthcare web services with different technological architectures and design approaches.

The goal of this study is to provide a large-scale automated evaluation of accessibility across Spanish public healthcare web services to obtain a broad overview of the accessibility status of these critical digital healthcare services. By analyzing a dataset of 57 official services covering all Spanish territories, we aim to identify general accessibility patterns, differences between service categories, and potential relationships between structural complexity and accessibility outcomes.

The remainder of this paper is organized as follows. Section II presents related work, Section III describes the methodology, Section IV presents the experimental setup,

Section V discusses the results, and Section VI concludes the paper and outlines future work.

II. RELATED WORK

Web accessibility has been extensively studied in the context of e-government systems, where public-sector websites frequently present barriers affecting navigation, form interaction, and compliance with accessibility standards. Systematic reviews of accessibility evaluation studies have shown that government portals are commonly assessed through a combination of automated tools and standards-based approaches based on the Web Content Accessibility Guidelines (WCAG) [1]. However, these reviews also highlight the methodological heterogeneity of existing studies, which often complicates cross-country comparisons of public digital services [2].

In the healthcare domain, accessibility is particularly critical because digital barriers may directly affect citizens' access to essential services. Previous studies evaluating eHealth portals have identified recurring accessibility problems in health-related websites across Europe, especially in systems that include critical interactive functionalities such as appointment booking or patient portals [3][4]. More recent literature reviews also emphasize that accessibility is still inconsistently incorporated throughout the design and evaluation lifecycle of digital health systems, despite the widespread adoption of WCAG as a reference framework [5]. From a methodological perspective, automated accessibility auditing tools such as Lighthouse [6], WAVE [7], and Axe [8] are frequently used for large-scale evaluations of web services. These tools enable scalable benchmarking of accessibility across large sets of websites, although they are typically considered complementary to manual inspection and user-based evaluation [9]. Despite the growing number of studies on web accessibility in both e-government and eHealth, there is still limited comparative evidence focusing on national public healthcare ecosystems as a whole.

In this context, the present work provides a large-scale automated audit of accessibility across Spanish public healthcare web services, covering all autonomous communities and the autonomous cities of Ceuta and Melilla. By systematically evaluating a dataset of official digital health services, this study aims to provide a comparative overview of accessibility across the Spanish public healthcare digital ecosystem.

III. DATASET

To conduct the accessibility evaluation, we compiled a dataset of official public healthcare web services belonging to the Spanish National Health System. Spain's healthcare system is decentralized across autonomous communities, each responsible for the management and operation of its regional healthcare services. As a consequence, each region has developed its own digital platforms to provide citizens with online healthcare services. The dataset includes 57 official web services covering all 17 Spanish autonomous communities as well as the autonomous cities of Ceuta and Melilla. The selection focused on citizen-facing services that represent the main interaction points between users and public healthcare systems. To ensure a representative sample of the digital health ecosystem, the dataset includes three main categories of services:

- Appointment booking systems, which allow citizens to schedule medical consultations.
- Patient portals, which provide access to personal health information and administrative services.
- Informational healthcare pages, which provide guidance or access points to digital health services.

These services were identified through the official websites of the regional healthcare services and the corresponding government portals. Only publicly accessible services were included in the dataset, ensuring that all evaluated pages could be accessed without authentication barriers. The final dataset therefore represents a broad overview of the Spanish public healthcare digital ecosystem, capturing both transactional services and informational platforms used by citizens across the country.

IV. METHODOLOGY

To evaluate the accessibility of the selected web services, we performed an automated accessibility audit using Google Lighthouse, an open-source auditing tool widely used for assessing web quality and accessibility. Lighthouse evaluates web pages according to several technical metrics, including accessibility, performance, and structural characteristics of the web interface. For each web service included in the dataset, an automated audit was executed using a headless browser environment. The evaluation process consisted of loading each web page and extracting the accessibility and performance metrics generated by Lighthouse. The following metrics were collected for each evaluated service:

- Accessibility score, which provides an aggregated indicator of accessibility compliance based on automated WCAG-related checks.
- Document Object Model (DOM) size, representing the structural complexity of the web page.

These metrics provide a quantitative overview of both accessibility compliance and technical characteristics of the evaluated services. The automated audit process was executed using a scripted pipeline that sequentially evaluated all URLs in the dataset and stored the resulting metrics in a structured dataset. This approach allows for

reproducibility and facilitates large-scale comparative analysis across services and territories.

After collecting the metrics, descriptive statistical analysis was performed to examine accessibility levels across the dataset. Additional analyses were conducted to explore differences between service categories and territories, as well as potential relationships between structural complexity and accessibility outcomes.

V. RESULTS

This section presents the results of the automated accessibility evaluation conducted on the dataset of Spanish public healthcare web services. We first provide an overview of the global accessibility levels observed in the dataset, followed by a comparative analysis across service categories and territories. Finally, we examine potential relationships between structural complexity and accessibility outcomes.

A. Overall Accessibility Levels

The accessibility evaluation reveals generally high accessibility levels across the healthcare services analyzed. The mean accessibility score across the dataset is approximately 0.90, with values ranging between 0.66 and 1.00. Most websites achieve scores above 0.85, indicating relatively good compliance with automated accessibility checks. However, the presence of lower scores suggests that accessibility issues still persist in some services. To better understand these results, we analyzed the most frequently detected accessibility violations reported by the automated evaluation tool (Table 1). The most common issues identified across the evaluated services include:

- Insufficient color contrast between text and background, which may reduce readability for users with visual impairments.
- Missing alternative text for images, preventing screen readers from properly conveying visual information.
- Form elements without associated labels, making it difficult for assistive technologies to interpret input fields.
- Buttons or links without accessible names, which can hinder navigation for screen reader users.
- Improper heading hierarchy, affecting the structural navigation of pages through assistive technologies.

Among these issues, insufficient color contrast and missing form labels appear as the most frequent violations across the evaluated services. These problems are particularly common in interactive healthcare services such as appointment booking systems, where complex forms and dynamic interface elements are widely used.

Overall, the distribution of accessibility scores suggests that while many healthcare services achieve relatively high automated accessibility scores, recurrent violations related to contrast, form accessibility, and semantic structure still affect a subset of services.

TABLE 1. MOST FREQUENT ACCESSIBILITY VIOLATIONS DETECTED ACROSS EVALUATED SERVICES

Accessibility issue	WCAG reference	Description	Frequency (services affected)
Insufficient color contrast	WCAG 1.4.3	Text elements do not provide sufficient contrast against their background	32
Form elements without associated labels	WCAG 1.3.1 / 4.1.2	Input fields are missing programmatically associated labels	28
Links without accessible names	WCAG 2.4.4 / 4.1.2	Anchor elements lack descriptive accessible text	24
Buttons without accessible names	WCAG 4.1.2	Interactive buttons are not properly labeled for assistive technologies	21
Images without alternative text	WCAG 1.1.1	Images lack descriptive alt attributes	19
Improper heading hierarchy	WCAG 1.3.1	Headings are not used in a consistent hierarchical order	17
Missing form input purpose	WCAG 1.3.5	Form fields do not specify autocomplete attributes	15
ARIA roles used incorrectly	WCAG 4.1.2	Incorrect or conflicting ARIA attributes detected	13
Low contrast in UI components	WCAG 1.4.11	UI controls or icons do not meet contrast requirements	12
Missing document language	WCAG 3.1.1	The HTML document does not declare the primary language	9

Table 1 summarizes the most frequent accessibility violations detected during the automated evaluation. The results indicate that contrast-related problems and form accessibility issues are the most common barriers across the evaluated healthcare services. In particular, insufficient color contrast and missing form labels appear in a substantial proportion of services. These problems are especially prevalent in interactive systems such as appointment booking platforms and patient portals, where complex forms and dynamic interface components are widely used.

B. Accessibility by Service Category

To complement the territorial analysis, the evaluated healthcare services were grouped into three major functional categories frequently identified across the analyzed regional healthcare ecosystems: appointment booking systems (“*cita previa*”), patient portals (“*portal paciente*”), and informational/service pages. The classification was derived from the functional taxonomy of the analyzed public healthcare services.

Informational and service-oriented pages achieved the highest overall accessibility performance, with a mean Lighthouse accessibility score of 0.913 (Standard Deviation

(SD) = 0.065, $n = 7$). Patient portals obtained an average score of 0.885 (SD = 0.095, $n = 18$), while appointment booking systems showed the lowest average accessibility score, with a mean value of 0.859 (SD = 0.088, $n = 18$). These results suggest that transactional healthcare services, particularly appointment booking systems, tend to present greater accessibility challenges than informational portals. This trend may be related to the higher interaction complexity and the presence of dynamic interface elements in appointment-management workflows. By contrast, informational pages generally contain more static content and simpler navigation structures, which may facilitate compliance with accessibility guidelines. Overall, these results suggest that the complexity of user interaction plays an important role in accessibility outcomes, particularly in services that require users to complete forms or navigate dynamic interfaces.

C. Accessibility Across Territories

Because the Spanish healthcare system is organized at the regional level, it is also relevant to examine whether accessibility levels differ between territories.

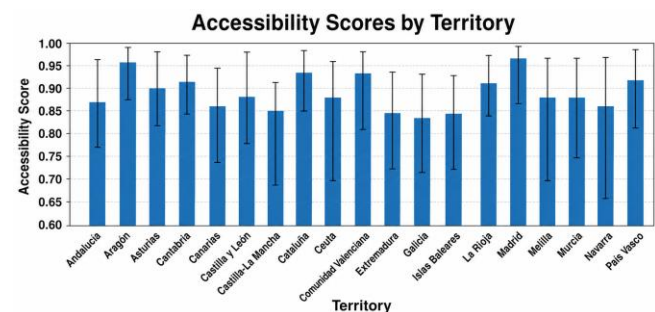


Figure 1. Average accessibility scores across territories.

Figure 1 presents the mean accessibility score for the healthcare web services associated with each autonomous community and autonomous city. Although most territories achieve relatively high accessibility levels, some regional healthcare platforms exhibit lower scores than others. These differences likely reflect variations in technological platforms, development practices, and accessibility policies adopted by regional healthcare administrations. Given the decentralized structure of the Spanish healthcare system, each autonomous community independently develops and maintains its digital healthcare services. As a result, accessibility outcomes may depend on regional design standards, technological frameworks, and development resources. Despite these differences, the results show that most territories achieved mean accessibility scores above 0.80 across the evaluated services, suggesting a generally acceptable level of automated accessibility compliance across the national healthcare ecosystem.

D. Structural Complexity and Accessibility

To explore the relationship between structural complexity and accessibility outcomes, we analyzed the size of the DOM for each evaluated service and compared it with the corresponding accessibility score obtained from the

automated Lighthouse audit. Across the evaluated dataset, DOM sizes showed substantial variability between services, ranging from relatively small informational pages to highly interactive transactional healthcare systems. Appointment booking services and patient portals generally exhibited larger DOM structures due to the presence of dynamic components, forms, authentication mechanisms, and multi-step interaction workflows. To statistically examine this relationship, a Spearman correlation analysis was conducted between DOM size and accessibility scores across the evaluated services ($n = 57$). The analysis revealed a statistically significant moderate positive correlation ($\rho = 0.54$, $p < 0.001$). Although larger DOM structures are commonly associated with increased interface complexity, the observed results suggest that structurally larger services in this dataset often incorporated more mature interface implementations, richer semantic organization, and more accessibility-oriented design practices. In contrast, some smaller services still exhibited important accessibility limitations despite their lower structural complexity. These findings indicate that DOM size alone is not a reliable predictor of accessibility quality. Instead, accessibility outcomes appear to depend more strongly on implementation practices, semantic correctness, and interaction design decisions than on structural size itself.

VI. CONCLUSIONS AND FUTURE WORK

This paper presented a large-scale automated evaluation of accessibility in Spanish public healthcare web services. By compiling a dataset of 57 official healthcare services covering all Spanish autonomous communities and the autonomous cities of Ceuta and Melilla, we conducted a comparative analysis of accessibility outcomes using automated Lighthouse audits. The results show that, overall, accessibility levels across the Spanish public healthcare digital ecosystem are relatively high, with a mean accessibility score close to 0.90. Most evaluated services achieved scores above 0.85, suggesting a generally good level of compliance with automated accessibility checks. However, the analysis also revealed important variability across both territorial healthcare platforms and service categories. Informational healthcare pages generally obtained the highest accessibility scores, whereas transactional systems such as appointment booking services and patient portals exhibited greater variability and lower average accessibility performance. These findings suggest that interaction-intensive services continue to pose greater accessibility challenges due to the presence of dynamic interfaces, forms, authentication workflows, and interactive components. The study additionally identified recurrent accessibility violations affecting multiple platforms, particularly insufficient color contrast, missing form labels, and interactive elements lacking accessible names. These problems were especially frequent in services involving user interaction and multi-step workflows, reinforcing the importance of accessibility-aware implementation practices in transactional healthcare systems. A correlation analysis

between DOM size and accessibility scores revealed a statistically significant moderate positive correlation ($\rho = 0.54$, $p < 0.001$). These results suggest that larger healthcare services in the dataset often incorporated more accessibility-oriented development practices, indicating that DOM size alone is not a reliable predictor of accessibility quality. From a broader perspective, the results highlight the challenges of ensuring accessibility in decentralized public digital ecosystems, where multiple regional administrations independently develop and maintain healthcare services. While the overall accessibility levels observed in this study are encouraging, the persistence of recurrent violations indicates that accessibility practices remain inconsistently implemented across platforms. Future work should extend the analysis beyond automated auditing by incorporating manual expert evaluation, user-centered accessibility testing involving people with disabilities, and longitudinal monitoring of accessibility evolution over time. Additional studies could also explore the relationship between accessibility, usability, service complexity, and user interaction patterns in public healthcare digital services.

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