Title Page

Title: Healthcare Signage Design: A review on recommendations for effective signing systems

Author 1: Rita Rodrigues | MSc in Industrial Design | PhD studentat EDAM – MIT Portugal | Instituto de Ciência e Inovação em Engenharia Mecânica e Engenharia Industrial, Faculdade de Engenharia, Universidade do Porto, Portugal

Author 2: Rita Coelho | PhD in Design | Invited Adjunct Professor at ESMAD | ESMAD – Escola Superior de Media Artes e Design, Instituto Politécnico do Porto, Portugal

Author 3: João Manuel R. S. Tavares | Habilitation in MechanicalEngineer | Associate Professor at FEUP | Instituto de Ciência e Inovação em Engenharia Mecânica e Engenharia Industrial, Departamento de Engenharia Mecânica, Faculdade de Engenharia, Universidade do Porto, Portugal

Corresponding Author (Author 3): tavares@fe.up.pt | Faculdade de Engenharia da Universidade do Porto, Departamento de Engenharia Mecânica, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, PORTUGAL | +351 93 420 1076 / +351 22 508 1487

Acknowledgments: This work was supported by "Fundação para a Ciência e a Tecnologia" (FCT), in Portugal, through a PhD grant with reference PD/BD/52348/2013 financed by national funds from "Ministério da Educação e Ciência" in Portugal, and by the European Social Fund through the POPH – QREN – Typology 4.1 – Advanced Training. The work was also supported by the Project NORTE-01-0145-FEDER-000022 - SciTech - Science and Technology for Competitive and Sustainable Industries, co-financed by "Programa Operacional Regional do Norte" (NORTE2020), through "Fundo Europeu de Desenvolvimento Regional" (FEDER).

Conflict of Interest: The authors declare no conflict of interest.

Human subjects protection approval: The authors declare that they did not need any approval since this study did not involve human subjects.

Keywords: Signage Systems, Design, Healthcare Facilities, Healthcare Environment, Wayfinding, User Perception.

Abstract

This article provides a set of recommendations, selected from the systematic literature review carried out, regarding signage systems for Healthcare institutions that can be used for designing or redesigning more competent signage systems. The signage systems in Healthcare settings are usually poorly designed due to the expansion of the original facilities, a lack of awareness of existing guidelines by the developers and a lack of agreement between the existing recommendations. There are several guidelines and recommendations available in the literature; however, each work was developed for specific cultural contexts, so there is a lack of uniformity among them. Hence, there is a need to uniformize the guidelines for signage design in healthcare, in order to provide supportive information for developers to build and implement effective and efficient signage systems. This study examined the available literature on the subject and established a set of guidelines organized in categories to help the design process. A literature review was conducted, and 34 selected publications were analyzed from which recommendations were created. A best-practices manual was also studied and used as the analytical framework to establish the design categories of the developed recommendations. This review resulted in guidelines divided into nine design categories that should be considered in the design process and implementation of signage systems in Healthcare facilities.

Keywords: Signage Systems, Design, Healthcare Facilities, Healthcare Environment, Wayfinding, User Perception.

Executive Summary

This article provides an analysis and selection of recommendations for designing effective healthcare signage. A review of peer-reviewed publications and manuals of best-practices on the subject was conducted, and design categories and their recommendations were established through an analytical framework based on one best-practices manual. The result is a set of guidelines for designing signage systems, divided into nine categories: 1) Text formatting; 2) Information hierarchy and density; 3) Language and terminology; 4) Symbols and pictograms; 5) Colors; 6) Placement, dimensions and typology; 7) Illumination, visibility and legibility; 8) Standardization; and 9) Inclusivity and user characteristics.

Due to limitations of publicly available literature, a few interesting publications may have not been included in the analysis. Nevertheless, the literature found, allowed important guidelines and recommendations for the signage design and implementation to be collected. The resultant recommendations should be of significant use to developers and designers who intend to develop a system of coordinated and articulated signs that comply with the existing guidelines and recommendations.

Implications for Practice

- The nine categories of recommendations (Text format; Information, hierarchy and density; Language; Symbols; Colors; Placement, dimensions and typology; Illumination, visibility, and legibility; Standardization; Inclusivity) created in this work bring suggestions for designing the graphical and physical characteristics of a signage system for healthcare settings, as well as for its implementation throughout the setting.
- Suggestions from the literature on methods to collect user opinions and perceptions (quantitative and qualitative) and methods to test the solutions made for the problems identified by users. The application of these methods means that the users are involved in the process of signage development.
- The guidelines and recommendations presented here make it easier for the developers of new or renewed signage systems to create elements that meet or exceed the user needs for their wayfinding tasks.
- Besides its benefits for the users, some of the recommendations and guidelines presented for wayfinding can reduce costs for the institution (costs with staff time wasted on providing directions, costs with lost users that end up increasing the time wasted, etc.).

Research shows that an improved hospital design can reduce stress of both patients and staff, increase efficacy of care, improve safety, and consequently improve the health outcomes of patients, and overall healthcare quality. Much of the available literature indicates that an efficient spatial layout and an effective signage can have positive effects on perceptions of patients concerning the overall service (Ulrich & Zimring, 2004; Chambers & Bowman, 2011).

As patients have greater access to information and take on more responsibility for their health, their demands to participate in their own hospital experiences grow (Carpman & Grant, 1993). Some scholars claim that designing supportive healthcare environments can enhance the recovery process and the psychological state of patients, mainly the elderly. Designers can help create these environments by considering the way users interact with the setting, which will therefore require user involvement in the design process. Besides the health care services of a hospital, users require also assistance in terms of wayfinding.

Trulove, Sprague, and Colony (2000) defined the term wayfinding as "Navigating from one place to another" and as "a very basic activity, one in which people engage throughout their lives." They suggest that wayfinding should be a problem-solving activity, in which decisions are made through the interpretation of a system of navigational features that should contain clear paths with visual, verbal and auditory clues.

One can say that wayfinding is a system represented by physical and graphical signs that help users to make sense of where they are and how to get to the place they are looking for. Karimi (2015) claims that research has shown that various aspects related to navigating and the layout of the buildings affect wayfinding and can consequently result in navigational errors.

Basri and Sulaiman (2013) say that the "frustration caused by wayfinding difficulties not only provokes a negative opinion of the physical setting but that it also affects the perception of the public itself and the services offered in that setting" (Basri & Sulaiman, 2013, p. 264). Changing the design of signage can be a way to improve user wayfinding abilities. Passini (1996) also shared this opinion when he argued that wayfinding difficulties can result in negative opinions of the physical setting, as well as undermine the name of the institute. Users end up having a negative experience due to getting lost in the building, miss an appointment because they were lost, or other problems resulting from a lack of synchronization between the wayfinding elements. To be effective and efficient, signage must be considered within the big picture of a wayfinding system, which means that its design and development should include and explore all wayfinding considerations, and take signs into account as well as the different characteristics of the users that visit and circulate inside healthcare settings.

Hughes and Brown (2015) found that people value being able to ask staff for directions. However, this is negative in terms of costs and time spent by staff giving directions to users. To overcome this, some institutions implemented methods created by Planetree, which is a non-profit organization that provides education for patient-centered healing environments (see http://planetree.org/reputation/). One of the strategies is to train all staff members to give directions in an appropriate way. However, if elements like signage or landmarks are not well designed or implemented, the staff will continue to have difficulties in giving directions effectively (Rechel, Buchan, & McKee, 2009). For example, Mora, Oats, and Marziano (2014), highlighted a study conducted by Ulrich in an American hospital with 604 beds, that showed that almost 4,500 hours per year were lost due to disorientated users asking for directions. This study says that in 2004, the costs due to disorientated users were estimated at US$202,000, which was equivalent to an

annual salary of a junior doctor. This means that even with a trained staff, if the physical elements of the wayfinding system are not efficient, the navigation difficulties will continue and the users will continue to lose their way.

To overcome such costs and impacts on the human resources, the signage systems need to be in coordination with the other features of the wayfinding system, such as the architecture, landmarks, etc. When poorly combined, there will be major navigation issues, which will result in negative consequences for the institution itself. Passini (1996) pointed out that:

"The ease of circulation within a building, the time saved by not having to consult

> confusing information displays and even the liberation from time consuming direction-giving by staff, are issues of building efficiency and have financial impacts that, admittedly, are not easy to calculate." (pp. 319-320).

Signage is definitely not the only element that should be considered in wayfinding, but it has been proved that it can reduce difficulties by preventing user confusion and frustration, reduce time spent by staff in giving directions, reduce the stress associated to wayfinding tasks, and consequently reduce costs (Carpman & Grant, 1993).

The purpose of this article was to assess the existing literature regarding the design of signage for healthcare, with the aim to select guidelines that can be used by the stakeholders involved in this design process. The result is a compilation of recommendations for the design of healthcare signage systems, gathered from the literature, and organized in design categories.

Method

Literature Selection Criteria

The selection of the literature was based on four criteria: (1) the studies should focus on wayfinding or signage systems for healthcare and should help answer the question: What are the characteristics and design requirements that signage should comply with? The studies must identify characteristics or problems from which recommendations can be created; (2) the studies could be peer-reviewed studies (research articles and literature reviews), best practices manuals (existing guidelines for healthcare signage), or regulations; (3) the research studies should include quantitative or qualitative research methods; and (4) all studies should be in English;

Databases and Search Steps

This literature review conducted from January to March 2016 accessed Science Direct, Scopus, and Springer databases, which provide public access to their documents. We extended the search to Google to include regulations and best practices manuals. The process was divided into four steps for selecting the literature, as shown in Figure 1.

[Place Figure 1 approximately here]

In the first step, we selected studies addressing at least one of the keywords. In the second step, we extended the search to Google to find regulations and best practices manuals, and we excluded duplicated articles. In the third step, the full texts of the remaining articles were analyzed in depth, through a full reading of each document. We assessed the quality of the articles through the criteria that articles should contain one of the following aspects: (1) research with actual users through qualitative or quantitative methods, and the methods used and results obtained should be fully described; (2) specific guidelines or recommendations relating to the graphical and physical design, as well as their implementation, for signage systems in health care institutions; (3) review of existing literature regarding wayfinding and signage systems, as well as available policies that

could contribute to the guidelines. In the final step, data from each document was organized in an Excel spreadsheet that contained the type of study, the place of publication, and the description. This table provided an organized source of the contents of the articles and helped to reduce the number of publications used to thirty-four (Table 1).

[Place Table 1 approximately here]

Analytical Framework

The analytical framework used to create the recommendations, is a manual of best practices focused for effective healthcare signage systems and was developed by the Department of Health (2005) in England. It was developed through extensive reviews of books, articles, together with the application of surveys on healthcare and non-healthcare settings, and opinions of experts. Although we could not find any specific criticisms to this manual, a report published by Ham, Berwick, and Dixon (2016), from The King's Fund in England, mentions that many of the policies adopted, might have placed England at the vanguard of improving the quality of care. It says that it will take time for the implemented policies to demonstrate results in the NHS, as occurred in other organizations that sought similar improvements. However, there are claims that the NHS "remains a great source of hope for nations committed to health and health care" (Ham et al., 2016, p. 29). It suggests that the NHS is a good example to follow, which leads one to believe that the proposed guidelines by theDepartment of Health (2005) have contributed to its success. In the Department of Health (2005) manual, 12 design recommendations are given for developing signage systems:(1) Typeface and type style; (2) Type size; (3) Text Layout and grouping; (4) Text and arrow alignment; (5) Emphasizing information; (6) Multiple language or dual terms; (7) Symbols; (8) Use of

color; (9) Positioning of signs; (10) Methods of construction; (11) Illuminating signs; (12) Special recommendations.

To create the desired recommendations, we have merged with the design categories defined in the aforementioned framework, some relevant information from the remaining literature. We found that, some of the design categories were also mentioned in other literature, but the categories were different or grouped in different ways. We synthesized and regrouped the categories from the Department of Health into nine categories:(1) Text formatting; (2) Information, hierarchy, and density; (3) Language and terminology; (4) Symbols and pictograms; (5) Colors; (6) Placement, dimensions, and typology of signs; (7) Illumination, visibility, and legibility; (8) Standardization; (9) Inclusivity and user characteristics. The first four categories suggested by the Department of Health (2005) are grouped into one single category, named Text formatting which contains all the information on typography. The ninth, tenth, and twelfth categories, are now designated as Placement, dimensions, and typology of signs, associated with sign typology, location, mounting dimensions, etc. A new category, named Standardization, regarding standards and regulations (category eight) was added. The ninth category presents recommendations for including users with disabilities. The documents collected from the databases were analyzed, in order to see which design categories were mentioned in each study and which ones were the most frequent (Table 2).

[Place Table 2 approximately here]

Results

A good wayfinding system goes beyond signage itself, and, to have a positive impact on user wayfinding experience, these systems must be combined with other physical features. Wayfinding systems are a result of a combination between architecture

(layout, floor configuration, etc.), landmarks (statues, paintings, etc.), colors, lighting, signs, people (verbal instructions, etc.), technologies (digital signs, smart phone applications, tactile ground surface indicators, Braille sign systems, etc.), and so on (Ministry of Health, 2014). In the following sections, recommendations are presented concerning the signage system as one of the features to consider when designing the wayfinding system of an institution.

Recommendations for Text Formatting

Signs should be designed and positioned so that they can be easily seen (Ministry of Health, 2014), and to ensure signage visibility and legibility, the viewing distances, fonts, lights, and layout of information must be planned. According to Boonyachut, Sunyavivat, and Boonyachut (2012), and Mollerup (2009), typography has the most influence on user comprehension of directions. The text size will vary according to its font; fonts with wider letter spacing will be able to use smaller text sizes, while condensed fonts require larger sizes. It is important to test the text size and its legibility at the location (Ministry of Health, 2014).

Also, Rousek and Hallbeck (2011) and Shim and Paik (2003) claim that the alignment, font type, font size, layout, and grouping can influence the way users interpret the message. Likewise, the consistency among all signage is extremely important, since each type of information should appear in the same format and layout throughout the whole setting (Ministry of Health, 2014), and in all signs (Berger, 2010).The Department of Health (2005) recommends specific font types (like Frutiger or Helvetica), and suggests the use of upper and lower-case letters to enhance reading, or the use of bold or regular typefaces to differentiate information. Similarly, the document from the Ministry of Health (2014) mentions that sans serif or typefaces with unobtrusive serifs should be used

with consistent thickness and spacing between letters and words. The document Americans with Disabilities Act 1990 (Board, 1990) gives specific recommendations on the proportion of the letters, and finishes to ensure contrast, and enhance legibility (Table 3).

[Place Table 3 approximately here]

Recommendations for Information Hierarchy and Density

Devlin (2014) and Hughes and Brown (2015), refer to the planning needed regarding the typology of signs to use, and the frequency with which they should be applied, in order to avoid overload or lack of information that is valuable. Hughes and Brown (2015) say that, when signage is too dense, inconsistent, or too redundant, it results in anxiety and stress for the users, which results in inefficient wayfinding. Khan (2013) tested seven different routes to three services and found that the amount of signage influenced user travel behavior. The author found that increasing the number of signs increases patient travel time, distance, number of stops, number of looking arounds, and of askings the staff for directions.

Martins and de Melo (2014), claim that information should be hierarchically organized. Information should be listed according to the degree of importance, and primary or secondary information should be emphasized by using colors, typefaces, or other methods. Different text weights, layouts, and colors can add or remove emphasis; for example, larger text implies more importance, while smaller text can mean less importance. This hierarchy can also be given through a variation of scales and position of some elements relatively to others (Ministry of Health, 2014). Pati, Harvey, Willis, and Pati (2015) found that, when signs show multiple destinations, users expect them to appear in the same order as on the directional signs. The fact that many authors refer to

this, reveals the importance of consistent and logical layout of information on signs (Table 4).

[Place Table 4 approximately here]

Recommendations for Language and Terminology

Mollerup (2009) stated that the terminology used on signs is too often an ignored tool to help the users and is one of the main causes of their wayfinding difficulties. Also, Carpman and Grant (1993) claimed that the medical and technical terms on the signs, many times, are not understood by the users. Ministry of Health (2014) suggests that clinical department titles should be avoided as the difficult and long words can easily be confused (such as Orthodontics, Orthopedics). So, it considers that descriptive and clear names should be used to create names easier to pronounce and remember. Similarly, Rousek and Hallbeck (2011) claim that the language used should be easily understandable, and long sentences, abbreviations, or difficult words should be avoided (Sunyavivat & Boonyachut, 2013).To overcome such barriers, many studies, as the one by Lee, Dazkir, Paik, and Coskun (2014), suggest the creation of a universal pictogram-based system, to be tested among users, to assess levels of comprehension. The Department of Health (2005) also recommends the combination of text with pictograms or colors (Table 5).

[Place Table 5 approximately here]

Recommendations for Symbols and Pictograms

Seventeen of the articles reviewed, advocated the use of symbols or pictograms on healthcare signage, and suggested recommendations for their design. Many, argue that communication is increased, when symbols are legible and easily understood by the user

(Boonyachut et al., 2012; Lee et al., 2014; Leonard, Verster, & Coetzee, 2014). Hashim, Alkaabi and Bharwani (2014) also claim that pictograms are more beneficial since they are more prominent, more noticeable and easier to remember than texts[1]. De Lobo (2010) also claims that there is a growing need for developing universal and recognizable symbols. Other authors, like Chambers and Bowman (2011) and Department of Health (2005), argue that further the development of pictograms and symbols, it is crucial to test them among the users as they can be interpreted in different ways, mainly due to different cultural backgrounds. To reduce difficulties in interpretation, Pati et al., (2015), Rousek and Hallbeck (2011) and Shim and Paik(2003) suggest that text should be used together with symbols, as this would facilitate their understanding, enhance interpretation, and help decipher their meaning. Summing up, symbols should be tested among the users, accompanied by text, larger than the text displayed on the sign, with a simple and clear design, and, for some symbols, in accordance with the ISO 7001 standard (Table 6).

[Place Table 6 approximately here]

Color Recommendations

The main problem in the use of colors is the lack of consistency in their use (Rooke, Tzortzopoulos, Koskela, & Rooke, 2009). Consistency not only for the colors used, to which there is no standardization, but also between the colors used on the signs and the colors on the brand of the institution. Department of Health (2005) and the document Americans with Disabilities Act 1990 (Board, 1990) say that if well applied, colors can help differentiate departments and emphasize information to help the user. Furthermore, the use of color to reinforce information can improve its clarity on the signs; however,

[1]A claim which is in line with what personalities such as Otto Neurath or Adrian Frutiger advocated almost 70 years ago, in the 20th century.

colors must be consistent from sign to sign and consider the established meanings of certain colors; for example, red is associated to emergency signs (Ministry of Health, 2014). Using colors requires planning, for example, some facilities often use colored line systems (on the floor or walls) to help guide the user; however, in large healthcare facilities, it is almost impossible to use them without creating a complexity of colored lines throughout the building (Carpman and Grant, 1993). Also, the way colors are perceived should be studied, as these settings receive a wide variety of users (Table 7).

[Place Table 7 approximately here]

Recommendations for Placement, Dimensions, and Typology

The design, location, and placement of the signage also seem to impact user wayfinding (Sadek, 2015). Tzeng and Huang (2009) claim that well placed signage will help users arrive at the destinations with less difficulty and less questions to the staff. Basri and Sulaiman (2013), and documents such as Americans with Disabilities Act 1990 (Board, 1990) have specific recommendations for the appropriate height and placement of signs. Additionally, the norm ISO/FDIS 3864-1:2001 (E) (Standardization, 2001) provides a formula (Table 8) to help calculate the distance at which signs should be positioned. Although the suggested formula can help in sign placement, it should not be used as a strict rule since the location itself depends on other factors. In general, signs should not be positioned right before or after an intersection point, as this will create confusion to the users. They should be visible from all directions and all viewing angles should be considered (Ministry of Health, 2014). Also Chambers and Bowman (2011) and Ulrich and Zimring (2004), gave some reference distances and recommendations for positioning signs. The Department of Health (2005) and Berger (2010) offer insights about placement and dimensions for directional, identification and location of signs.

[Place Table 8 approximately here]

Recommendations for Illumination, Visibility, and Legibility

This category (Table 9) is extremely important, as light can affect the visibility and legibility of signs (Basri & Sulaiman, 2013; Rousek & Hallbeck, 2011). The illumination of signs can be internal (light source within the sign) and it should have illuminated text on a non-illuminated background as this increases legibility and visibility of the text, or external (light source projected onto the sign) in which care must be taken in order to avoid reflection or glare, as shadows created by the light can reduce legibility (Ministry of Health, 2014). Along with signage placement, another factor affecting sign legibility is the surface finish. Some materials can reduce legibility, for example, bright materials can produce glare (Rousek & Hallbeck, 2011). Some of the studies provide specific recommendations regarding levels of light, the use of artificial or natural light, the material finish on signs, and ways to avoid or reduce the glare or reflection (Department of Health, 2005; Berger, 2010; Association, 2002).

[Place Table 9 approximately here]

Recommendations for Standardization

There is a huge **need to create universal and standard guidelines for designing and implementing signage systems in healthcare.** Leonard et al. (2014), found that, to be effective, signage needs to be consistent and under a standardized design throughout the whole building. Rousek and Hallbeck (2011) mention two specific regulations that should be used, which are: The American National Standards – ANSI Z535.1-5 (Association, 2002), and the norms ISO/FDIS 3864-1:2001 (E) (Standardization, 2001) and ISO 9186-3 (Standardization, 2014). Although the above mentioned standards are mainly specific for safety and regulatory signs, some of the information can also be useful

for navigational signage. For example, the Americans with Disabilities Act (Board, 1990) document, although it was developed for inclusive purposes, has a specific section related to signage. Some specific best-practice manuals, like the Universal Symbols in Health Care Workbook (Berger, 2010) and Wayfinding Guidance for Healthcare Facilities (Department of Health, 2005) can be useful guides, and can contribute to create the regulations needed for standardization (Table 10).Although there are general regulations concerned with signage systems, the developers of healthcare facilities would certainly benefit from new or refined policies based on recommendations or manuscripts like the ones described above. There are a lot of policies related to regulatory or safety signage, but less is available for the graphical, physical and implementation characteristics of the signage for healthcare settings.

[Place Table 10 approximately here]

Recommendations for Inclusivity and Characteristics of the User

This specific design category (Table 11) groups the inclusivity of disabled users like the blind, color-blind, visually impaired people, and the elderly (De Lobo, 2010). The elderly are a huge proportion of the population that use these facilities, and so, additional measures, such as trained staff, assistive technologies and architectural elements, should be considered when designing the navigational signage in these settings (Ministry of Health, 2014). These users and the ones with temporary or other permanent disabilities lead to specific concerns in signage design and implementation. Harun, Hamid, Talib and Rahim (2011) mentioned some characteristics of the users, like age, language, cultural background, and literacy levels that should be considered. They suggest that alternative wayfinding systems can be applied to complement the traditional signs, for example talking signs, interactive maps, etc. (Harun, Hamid, Talib, & Rahim, 2011). The signage

systems should be analyzed through the eyes of the users and, as mentioned by Kaya, Ileri, and Yuceler (2016):

> "The elements contained in a signage system have to be compatible with the elements of landscape architecture, illumination system, visual identity and architectural design of that particular venue, and the wayfinding system has to be built in a way so as to respond to the requirements of the target audience." (p. 35).

Also, familiarity with the facilities can play a role in navigational abilities. Tang, Wu, and Lin (2009) conducted a study to test user wayfinding capabilities in three different scenarios: without emergency signs, with the old version of signs, and with a new version. They found that, familiarity with the old signs makes them easily interpretable, although the new signs had a better design. They concluded that past recognition can influence signage interpretation. If a study shows that most people feel more difficulties in interpreting the new signage although it had a better design, then, for people with disabilities that heavily rely on their past recognition of the settings to navigate, for example, the visual impaired people, changes in the signage and wayfinding features of the settings can negatively impact their navigational abilities. Therefore, when implementing a new signage system or redesigning an existing one, the institutions should try to minimize the impact of those changes on the users.

[Place Table 11 approximately here]

Discussion and Conclusion

This review focused on the influence that signage can have on user wayfinding abilities and experiences within healthcare services. **Some of the findings could be the basis for recommendations, as they contributed with specifications for developing and designing new signage systems for healthcare.** Recommendations on text formatting

and layout, and on symbols and pictograms, seem to be the most important as they are the ones with the most impact on the users. The characteristics of the text influence the way people understand written messages, and many times this is the most important part of the signage. Also, by associating symbols or pictograms, the inclusion of users with disabilities can be enhanced. Keeping in mind that the context in which the signage will be implemented should be considered and analyzed as each case has its own particularities.

The manual from the Department of Health (2005) was developed with direct interaction with healthcare users, and more studies like this are needed to provide a better understanding of how users experience and interpret the signage, and how those experiences can contribute to produce better designs for wayfinding systems. The Department of Health manual provides tools to help evaluate current signage systems, and moreover, it offers tools that can be the basis to involve the user in the process, particularly, quantitative and qualitative tools to apply in a real context. Hence, it can help define the tools to involve users in the process of design and development of signage systems for healthcare. Many recommendations result from the application of post-occupancy evaluation studies in which recommendations are generated based on the stakeholders' experiences of the buildings. In such environments like healthcare, the use of trials and post-occupancy tests can make a real difference.

Much of the literature reviewed is focused on patient needs, and little or no literature is focused on the staff and visitors, which also constitute a large group of users. Visitors tend to be forgotten, and they rarely use the facilities so their needs for signage can be huge compared to a patient that regulary uses the setting. Carpman and Grant (1993) mention a study entitled "Wayfinding design research: respecting the needs of patients and visitors", where the largest source of stress was for visitors trying to find

their way inside the hospital. Also, for the staff, the signage available can be important to help provide accurate directions to the users. **The level of evidence regarding the needs of these two groups in the literature is scarce and more research is needed to create signage systems that serve the various different users.**

Limitations of the Study

It is possible that relevant databases were overlooked, and with the keywords and inclusion criteria, some recommendations may have been disregarded or lost. Although we tried to retrieve the most important information, the limited access to the literature may have limited the numbers of documents analyzed.

References

Berger, C. (2010). Universal Symbols in Health Care Workbook: Best Practices for Sign Systems. United States: Robert Wood Johnson Foundation.

Basri, A. Q., & Sulaiman, R. (2013). Ergonomics Study Of Public Hospital Signage. *Advanced Engineering Forum, 10,* 263-271. doi:10.4028/www.scientific.net/AEF.10.263

Boonyachut, S., Sunyavivat, C., & Boonyachut, N. (2012). Hospital Wayfinding through Directional Sign on Logistics Concept. *Proceedings of the Asian Conference on Arts and Humanities* (pp. 901-911). Osaka, Japan: Iafor.

Carpman, J. R., & Grant, M. A. (1993). *Design that cares: Planning health facilities for patients and visitors* (2nd ed.). New York, United States of America: American Hospital Publishing, Inc.

Chambers, M., & Bowman, K. L. (2011). Finishes and furnishings: Considerations for critical care environments. *Journal of Critical Care Nursing Quarterly, 34*, 317-331. doi:10.1097/CNQ.0b013e31822bad05

De Lobo, T. (2010). Legibility for users with visual disabilities. In S. Cervai & D. Horner (Eds.), *Proceedings of the First International Conference on Technology enhanced learning: Quality of teaching and educational reform* (pp. 92-102). Athens, Greece: Springer International Publisher.

Department of Health. (2005). *Wayfinding: Effective Wayfinding and Signing Systems Guidance for Healthcare Facilities*. London, United Kingdom: Colette Miller and David Lewis.

Devlin, A. S. (2014). Wayfinding in healthcare facilities: Contributions from environmental psychology. *Journal of Behavioral Sciences, 4*, 423-436. doi: 10.3390/bs4040423.

Ham, C., Berwick, D., & Dixon, J. (2016). *Improving quality in the English NHS*. England: The King's Fund. Retrieved from https://www.kingsfund.org.uk/publications/quality-improvement

Harun, S. N., Hamid, M. Y., Talib, A., & Rahim, Z. A. (2011). "Usability evaluation": Criteria for quality architecture in-use. *Journal of Procedia Engineering, 20*, 135-146. doi:10.1016/j.proeng.2011.11.148.

Hashim, M. J., Alkaabi, M. S. K. M., & Bharwani, S. (2014). Interpretation of way-finding healthcare symbols by a multicultural population: Navigation signage design for global health. *Journal of Applied Ergonomics, 45*, 503-509. doi: 10.1016/j.apergo.2013.07.002

Hughes, N., & Brown, M. (2015). Navigating To and Through Large Hospitals. In K. Christer (Ed.), *Proceedings of the 3rd European Conference on Design4Health*, Sheffield, United Kingdom: Sheffield Hallam University. Retrieved from https://research.shu.ac.uk/design4health/wp-content/uploads/2015/07/D4H_Hughes_Brown.pdf

International Organization for Standardization. (2014). *Graphical symbols — Test methods — Part 3: Method for testing symbol referent association*. (ISO Standard No. 9186-3). Retrieved from https://www.iso.org/standard/59882.html

International Organization for Standardization. (2001). Graphical Symbols - Safety colors and safety signs. (ISO/FDIS Standard No. 3864-1:2001). Retrieved from https://www.iso.org/standard/51021.html

Kaya, S. D., Ileri, Y. Y., & Yuceler, A. (2016). Importance of hospital way-finding system on patient satisfaction. In H. M. Bilgin, H. Danis, E. Demir, & U. Can (Eds.), *Business challenges in the changing economic landscape - Vol. 2: Proceedings of the 14th Eurasia business and economics society Conference* (pp. 33-40). Barcelona, Spain: Springer International Publishing.

Karimi, H.A. (2015). *Indoor Wayfinding and Navigation*: CRC Press.

Khan, N. (2013). *Spatial correlates of patients' travel experience & satisfaction in hospital outpatient department.Architectural Research Centers Consortium*.

Lee, S., Dazkir, S. S., Paik, H. S., & Coskun, A. (2014). Comprehensibility of universal healthcare symbols for wayfinding in healthcare facilities. *Journal of Applied Ergonomics, 45*, 878-885. doi: 10.1016/j.apergo.2013.11.003.

Leonard, A. L., Verster, A., & Coetzee, M. (2014). Developing family-friendly signage in a South African paediatric healthcare setting. *Journal of Curationis, 37*, 7. doi: 10.4102/curationis.v37i2.1250.

Martins, L. B., & de Melo, H. F. V. (2014). *Wayfinding in Hospital: A Case Study*. In A. Marcus (Ed.), *Proceedings of the Third International Conference of Design, User Experience, and Usability* (pp. 72-82). Crete, Greece: Springer International Publisher.

Ministry of Health, NSW. (2014). *Wayfinding for Healthcare Facilities*. (Standard No. GL2014_018). Retrieved from

http://www.healthshare.nsw.gov.au/__data/assets/pdf_file/0005/321998/Wayfinding_for_Healthcare_Facilities_-_Guideline.pdf

Mollerup, P. (2009). Wayshowing in hospital. *Australasian Medical Journal, 1*, 112-114. doi: 10.4066/AMJ.2009.85

Mora, R., Oats, A., & Marziano, P. (2014). A survey about client orientation and wayfinding in Chilean hospitals. *Revista Medica Chile, 142,* 1291-1296. doi: 10.4067/S0034-98872014001000009

National Electrical Manufacturers Association. (2002). American National Standard for Safety Color Code. (ANSI Z Standard No. 535.1). Retrieved from https://www.nema.org/Standards/ComplimentaryDocuments/ANSI%20Z535_1-2017%20CONTENTS%20AND%20SCOPE.pdf

Passini, R. (1996). Wayfinding design: logic, application and some thoughts on universality. *Design Studies, 17*, 319-331. doi: 10.1016/0142-694X(96)00001-4

Pati, D., Harvey, T. E., Jr., Willis, D. A., & Pati, S. (2015). Identifying elements of the health care environment that contribute to wayfinding. *Health Environments Research and Design Journal, 8*, 44-67. doi: 10.1177/1937586714568864

Rechel, B., Buchan, J., & McKee, M. (2009). The impact of health facilities on healthcare workers' well-being and performance. *International Journal of Nursing Studies, 46*, 1025-1034. doi: 10.1016/j.ijnurstu.2008.12.008

Rooke, C. N., Tzortzopoulos, P., Koskela, L., & Rooke, J. (2009). *Wayfinding: embedding knowledge in hospital environments.* Proceedings of the HaCIRIC 2009: Improving Healthcare Infrastructures Through Innovation, Brighton,

United Kingdom. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.392.4803

Rousek, J. B., & Hallbeck, M. S. (2011). Improving and analyzing signage within a healthcare setting. *Journal of Applied Ergonomics, 42*, 771-784. doi: 10.1016/j.apergo.2010.12.004

Sadek, A. H. (2015). A comprehensive approach to facilitate wayfinding in healthcare facilities. In K. Christer (Ed.), *Proceedings of the 3rd European Conference on Design4Health*, Sheffield, United Kingdom: Sheffield Hallam University. Retrieved from https://research.shu.ac.uk/design4health/wp-content/uploads/2015/07/D4H_Sadek.pdf

Shim, E., & Paik, J. (2003). The Effect of Letter Factors in Signs on the Visual Perception: In Case of Layout. *Proceedings of the 6th Asian Design Conference,* Tsukuba, Japan.

Sunyavivat, C., & Boonyachut, S. (2013). Essential of Pictograms for Effective Hospital Signage. *Proceedings of the The European Conference on Arts & Humanities* (pp. 67-79). Brighton, United Kingdom: iafor.

Tang, C.-H., Wu, W.-T., & Lin, C.-Y. (2009). Using virtual reality to determine how emergency signs facilitate way-finding. *Journal of Applied Ergonomics, 40*, 722-730. doi: 10.1016/j.apergo.2008.06.009

Trulove, J.G., Sprague, C., & Colony, S. (2000). *This Way: Signage Design for Public Spaces*: Rockport.

Tzeng, S. Y., & Huang, J. S. (2009). Spatial forms and signage in wayfinding decision points for hospital outpatient services. *Journal of Asian Architecture and Building Engineering, 8*. doi:10.3130/jaabe.8.453

Ulrich, R., & Zimring, C. (2004). *The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity*. Texas, United States: Robert Wood Johnson Foundation. Retrieved from: https://www.healthdesign.org/system/files/Ulrich_Role%20of%20Physical_2004.pdf

United States Access Board. (1990). *Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities*. (Appendix A to Part 1191). Retrieved fromhttps://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag

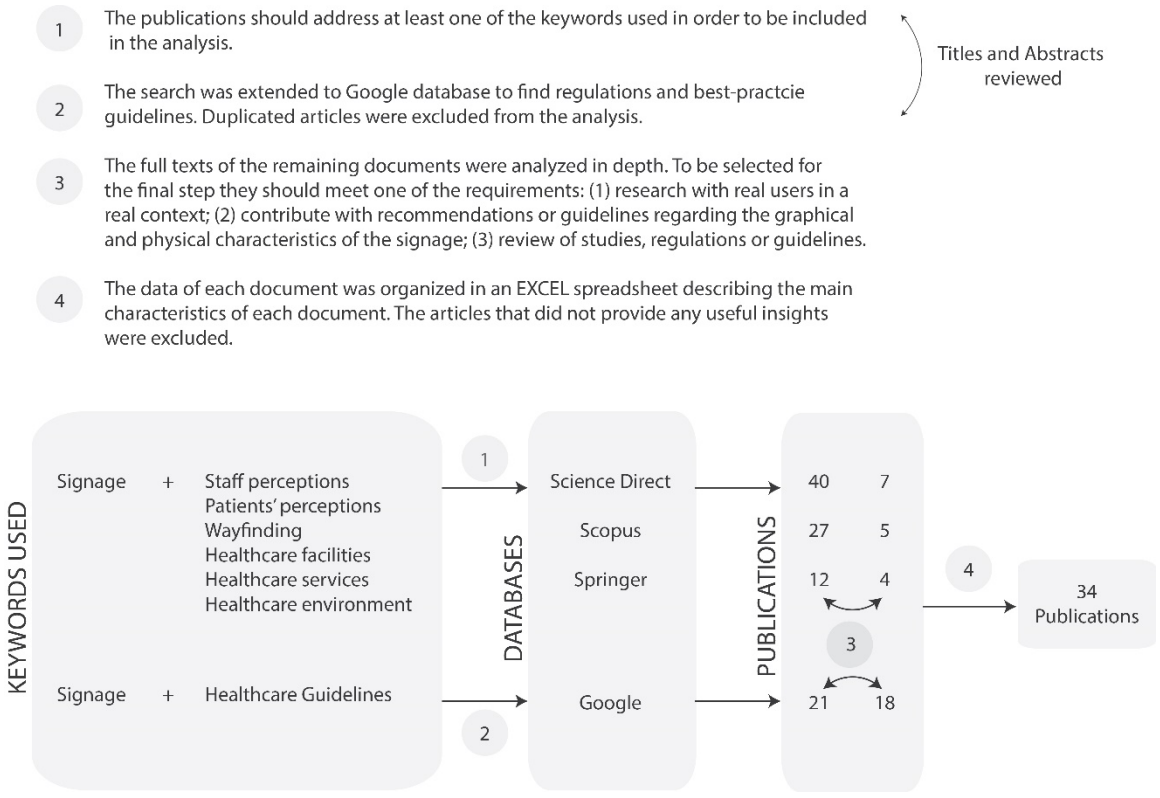


Figure 1. Literature Review Process

Publicatio	Reference	Country	Peer-	Best	Description of the study
1	(Basri & Sulaiman, 2013)	Malaysia	x		It studies the user height preferences of signage in a specific hospital, and proposes an appropriate height based on the results.
2	(Boonyachut , Sunyavivat, & Boonyachut (2012)	Thailand	x		Studies the benefits of combining pictograms and lettering on signage for hospital users.
3	(Chambers & Bowman, 2011)	United States		x	Recommendations regarding elements (like signage) that can help create a familiar environment in healthcare.
4	(Carpman & Grant, 1993)	United States		x	Written by decision makers, it offers guidelines to apply on redesigns, small scale changes, and new healthcare facilities.
5	(Devlin, 2014)	United States	x		The review presents considerations for creating effective wayfinding systems for healthcare.

Publicatio	Reference	Country	Peer-	Best	Description of the study
6	(Ministry of Health, 2014)	Australia		x	Provides guidelines to develop a good wayfinding system for healthcare facilities and introduces tools to design and improve these systems.
7	(Harun, Hamid, Talib, & Rahim, 2011)	Malaysia	x		Analyzes the usability of the architecture. In addition, it gathers user feedback regarding navigation within the hospital.
8	(Hashim, Alkaabi,& Bharwani, 2014)	United Arab Emirates	x		Analyzes a set of healthcare symbols (Hablamos Juntos Foundation) and tries to understand how users interpret them.
9	(Hughes & Brown, 2015)	United Kingdom	x		Tries to identify the navigational issues that impact the user wayfinding experience within the hospital.
10	(Kaya, Ileri, & Yuceler, 2016)	Turkey	x		A study of new route arrangements to solve complaints regarding wayfinding difficulties.

Publication	Reference	Country	Peer-	Best	Description of the study
11	(Khan, 2013)	United States	x		Analyzes how wayfinding problems can impact the user experience and satisfaction with the healthcare service.
12	(Lee, Dazkir, Paik, & Coskun, 2014)	United States, Korea, Turkey	x		Tests universal healthcare symbols in three countries to compare the comprehension levels of symbols across-countries.
13	(Leonard, Verster, & Coetzee, 2014)	South-Africa	x		Reviews the current signage system of a pediatric hospital to develop a new signage system more centered on users.
14	(De Lobo, 2010)	Portugal	x		Highlights the needs of the visually impaired users about elements that contribute to wayfinding, such as signage.
15	(Martins & de Melo, 2014)	Brazil	x		Tries to understand how people orientate themselves in large complex buildings and suggests solutions to improve their wayfinding.

Publicatio	Reference	Country	Peer-	Best	Description of the study
16	(Mollerup, 2009)	Australia		x	Describes the problems of wayfinding that occur in hospitals and suggests solutions.
17	(Mora, Oats, & Marziano, 2014)	Chile	x		Explores user wayfinding experiences in Chilean hospitals considering the available signage systems.
18	(Passini, 1996)	Canada	x		Explores the concept of wayfinding, and provides some insights regarding universality and its concepts.
19	(Pati, Harvey, Willis, & Pati, 2015)	United States	x		Identifies the aspects of the physical environment of a healthcare setting that contribute to wayfinding by visitors.
20	(Rechel, Buchan, & McKee, 2009)	United Kingdom	x		The article explores how the design of the healthcare settings impacts the well-being and performance of workers. Six design factors that impact the staff work are presented: Location, hospital experience, personal space, choice of

Publicatio	Reference	Country	Peer-	Best	Description of the study
					materials, environmental safety, and commodities for staff.
21	(Rooke, Tzortzopoulos, Koskela, & Rooke, 2009)	United Kingdom	x		Shows that wayfinding tasks are possible using various systems besides just signage. The aim was to use embedded forms of knowledge that make it easier for people to find their way.
22	(Rousek & Hallbeck, 2011)	United States	x		Analyzes standardized healthcare pictograms (Hablamos Juntos Foundation) and the effects that color have on different users.
23	(Sadek, 2015)	United States		x	Reviews elements of the physical environment that facilitate wayfinding in healthcare settings, and establishes relations between environmental elements and health outcomes.
24	(Shim & Paik, 2003)	Korea	x		Focused on the location of signs and text formatting conditions that enhance user experience of wayfinding.

Publication	Reference	Country	Peer-reviewed	Best practice	Description of the study
25	(Sunyavivat & Boonyachut, 2013)	Thailand	x		Analyzes the effect on users of signage combining pictograms with text and signage that only uses pictograms.
26	(Tang, Wu, & Lin, 2009)	Taiwan	x		Tests user response to three different scenarios with different signage.
27	(Ulrich & Zimring, 2004)	United States		x	Provides recommendations regarding elements that should be considered in the design of healthcare settings.
28	(Tzeng & Huang, 2009)	Taiwan	x		Analyzes the influence of wayfinding decisions and signage on user wayfinding abilities.
29	(Board, 1990)	United States		x	Technical requirements and considerations for people with disabilities to healthcare facilities.
30	(Association, 2002)	United States		x	Sets specifications and test methods for safety colors to be used in signage in order to establish uniformity in color coding.

Publicatio	Reference	Country	Peer-	Best	Description of the study
31	(Standardization, 2001)	Switzerland		x	Specifications regarding graphical symbols for public spaces, safety colors, and signs.
32	(Department of Health, 2005)	United Kingdom		x	Assesses the problems of wayfinding in healthcare settings by analyzing and setting recommendations for elements that can influence wayfinding.
33	(Berger, 2010)	United States		x	Recommendations regarding the use of symbols in signage for healthcare settings together with other elements that influence signage effectiveness.
34	(Standardization, 2014)	Switzerland		x	Methodology for creating healthcare symbols and for testing them on users.

Table 1. Publications selected for the literature review.

			Design Categories								
			Text Formatting	Information Hierarchy/ Density	Language and	Symbols and	Colors	Placement/Dimensions	Illumination/Visibility/ Legibility	Standardization	Inclusivity & User
Literature Reviewed	**1**	(Basri & Sulaiman, 2013)				x	x	x	x		
	2	(Boonyachut, Sunyavivat, & Boonyachut (2012)	x			x	x				x
	3	(Chambers & Bowman, 2011)						x			
	4	(Carpman & Grant, 1993)			x	x	x	x	x	x	x
	5	(Devlin, 2014)		x	x	x		x			x
	6	(Ministry of Health, 2014)	x	x	x	x	x	x	x		x
	7	(Harun, Hamid, Talib, & Rahim, 2011)						x			
	8	(Hashim, Alkaabi, & Bharwani, 2014)				x					x
	9	(Hughes & Brown, 2015)		x				x			
	10	(Kaya, Ileri, & Yuceler, 2016							x		
	11	(Khan, 2014)		x							x
	12	(Lee, Dazkir, Paik, & Coskun, 2014)			x	x					x
	13	(Leonard, Verster, & Coetzee, 2014)				x				x	
	14	(De Lobo, 2010)				x				x	x

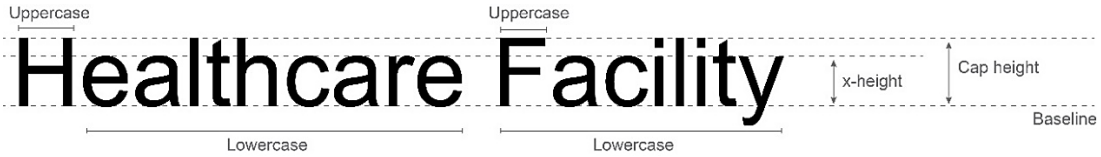
15	(Martins & de Melo, 2014)		x	x						
16	(Mollerup, 2009)	x		x	x	x	x			x
17	(Mora, Oats, & Marziano, 2014									x
18	(Passini, 1996)		x							x
19	(Pati, Harvey, Willis, & Pati, 2015)		x		x		x			
20	(Rechel, Buchan, & McKee, 2009)								x	
21	(Rooke, Tzortzopoulos, Koskela, & Rooke, 2009					x	x			
22	(Rousek & Hallbeck, 2011)	x		x	x	x	x	x	x	x
23	(Sadek, 2015)						x			
24	(Shim & Paik, 2003)	x			x					
25	(Sunyavivat & Boonyachut, 2013)				x	x				x
26	(Tang, Wu, & Lin, 2009)									x
27	(Ulrich & Zimring, 2004)						x			
28	(Tzeng & Huang, 2009)						x			
29	(Board, 1990)	x			x		x			x
30	(Association, 2002)					x		x		
31	(Standardization, 2001)				x	x	x			
32	(Department of Health, 2005)	x	x	x	x	x	x	x		
33	(Berger, 2010)	x			x	x	x	x		x
34	(Standardization, 2014)				x					x
Number of times mentioned		8	8	8	19	12	18	8	5	17

Table 2. Design categories mentioned in each of the reviewed literature.

1. **Text Alignment:**
   - Use two or three-word alignment.
   - Destinations with less than five words and text aligned to the left.
2. **Font Type:**
   - A Sans serif typeface or a typeface with very small serif is recommended.

Serif typeface	Sans serif typeface
Garamond	Arial

   - The typeface should have a large x-height and consistent thick stems (see example below):



   - Recommended typefaces: Frutiger, Franklin Gothic, Health Alphabet, Helvetica, and Univers.
3. **Upper-Case vs Lower-Case lettering:**
   - Use an upper-case for the first letter and lower-case for the remaining ones. This will:
     - create more distinctive word shapes,
     - and make the words easier and quicker to read.
   - Upper-case can be used to emphasize a single destination on a sign; however, other methods should be considered first.
4. **Bold vs Regular Typefaces:**
   - Use bold for primary information.
   - Use regular for secondary information.
5. **Characters, Proportions and Height:**
   - Proportions:
     - Letters and numbers should comply with a width-to-height ratio between 3:5 and 1:1, and a stroke-width-to-height ratio between1:5 and 1:10.
   - Height:
     - Letters and numbers should be sized according to the viewing distance (see table below).

Example of viewing distances for "Health Alphabet" typeface (HTM 65, 1984)

x-height	Viewing distance (healthy vision – acuity of 6/9)	Viewing distance (partially sighted – acuity of 6/60)	Recommended sign typology
15 mm	Up to 7.5m	No more than 0.5m	Directories
30 mm	Up to 15m	No more than 1m	Door identification
40 mm	Up to 20m	No more than 1.5m	Internal identification and
60 mm	Up to 30m	No more than 2m	Internal and external signs
90 mm	Up to 45m	No more than 3m	External identification and
120 mm	Up to 60m	No more than 4m	Identification signs
200 mm	Up to 100m	No more than 7m	Fascia signs

Adapted from Department of Health (2005) p. 75

- Use a larger type size for suspended signs from the ceiling than for signs positioned at eye level (the viewing distance will be greater).

6. <u>Finish and Contrast:</u>

- Characters and background should be eggshell, matte, or any other non-glare finish.
- Characters should be either with light colors on dark background or the reverse.
- Some references recommend the use of white on a grey background, or red on a black background.
- The following formula can be used to calculate the contrast between the colors:

Contrast = [(B1 - B2) / B1] x 100

B1 - Is the light reflectance value (LVR) of the lighter area of the sign
B2 - Is the LVR of the darker area of the sign

Adapted from Board (1990) p. 122

Table 3. Recommendations for Text Formatting.

1. **Degree of Importance and Hierarchy of Information:**
   - The method for emphasizing information should be consistent on all signs.
   - The order of destinations should be consistent, logical, and following a degree of importance.
2. **Quantity of listed Information:**
   - List no more than five destinations on a sign.
3. **Grouping Information on Signs**
   - When possible (departments close to each other), group related departments under one name.
   - When directional signs have more than five destinations, they must be clearly grouped into shorter lists by gathering the destinations by (see figure below):
     - direction,
     - function,
     - alphabetic order,
     - or using visual elements like spaces, lines or colors.

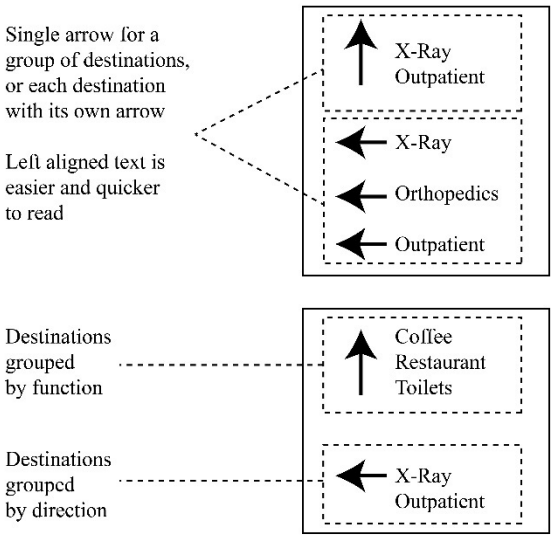
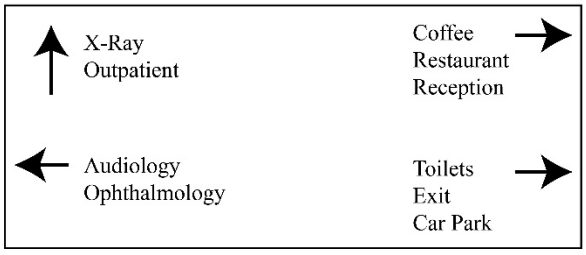


Table 4. Recommendations for Information Hierarchy and Density.

1. **Language and terminology:**
   - Some medical terms are not understood by visitors. Ensure the use of plain and easily understandable language;
   - Avoid difficult names and abbreviations;
   - Use short sentences that are easier to understand and memorize;
   - Distinguish the terms with the help of different typeface weights, color contrasts, and combinations of lines, spaces, or positions.

Table 5. Recommendations for Language and Terminology used in signage.

1. **User Interpretation:**
   - Symbols are interpreted in different ways.
   - Abstract or oversimplified symbols are difficult to interpret.
   - Interpretation varies with age, culture, and literacy.
   - It is important to test symbols among users.
2. **Benefits of using symbols or pictograms:**
   - Symbols or pictograms are easier to see from greater distances and more likely to be understood by users with different cultural backgrounds, age, and literacy levels.
   - Studies indicate that pictograms take about half the time to be understood compared to signs with text only.
3. **Design Characteristics:**
   - Symbols and pictograms should use representations of the referent that are visually simple and consistent.
   - Silhouette side views are preferable to frontal views when representations of the human body are used since they are easier to understand.
   - Solid areas of colors instead of colored outlines.
   - Distinct from other specific symbols to avoid confusion.
   - Brightly colored to stand out from the background, and with the text in a contrasting color.
   - Some studies indicate that use of human shapes result in higher rates of comprehension.
   - Some departments deal with body parts that are easier to explain in symbols (for example: eyes or feet).
4. **Symbols combined with Text:**
   - Symbols together with text and repeatedly exposed, allow the users to learn their meaning.
   - Text positioned below the pictogram.
   - Symbols are not intended to replace text. They should be integrated together with the text, and their relationship should be clear.
5. **Location of Symbols and Pictograms:**
   - Considerations for location of arrows (see figure below):
     - Up and down arrows can be interpreted as forward, backward, upward, and downward depending on the subject.
     - Should be clearly linked to the text they relate to.
     - Should clearly indicate the appropriate direction.
     - Not too much space between the text and arrow.
     - Aligned and consistently positioned in all signs.



• Consult standard position and meaning for arrows on signs specified in the British Standard for fire safety signs, notices, and graphic symbols (BS 5499: Part1:1990).
6. Dimensions of Symbols and Pictograms
• Symbols should be larger than text so that the symbol is the first element seen by users.
• Symbols or pictograms should be at least 76.20 to 203.2 mm in height to be legible.

Table 6. Recommendations for Symbols and Pictograms.

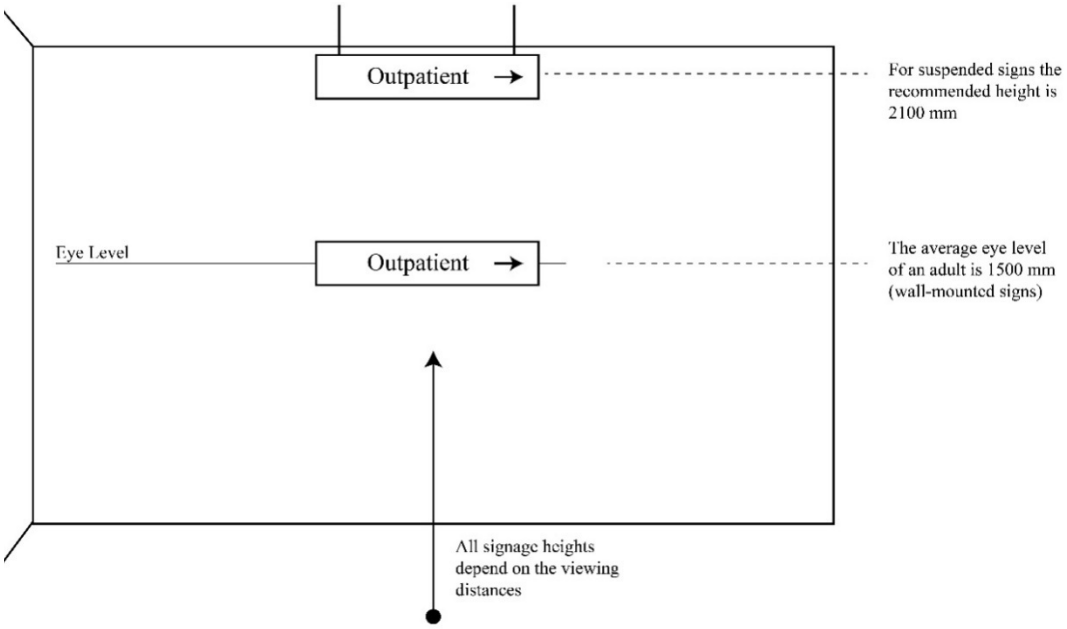
1. **Contrast between elements:**
   - Sign colors must contrast with the background, and the text color should stand out from the sign plate.
   - Dark colors used with white letters, or light colors with dark letters.
   - Color contrast should be between 60 and 70%.This contrast can be calculated through color contrast calculators like the one suggested by ASI – Modulex (www.asi-modulex.com).
   - Color can be used to differentiate departments, sectors, or emphasize information.
   - If the signs are positioned on a white wall, a color rather than white should be selected for the background of the sign. Another option is to place a contrasting border on the sign to make it stand out. The use of two or more contrasting colors (like for example black and white) should be taken into account.

   - In a system of colored lines on the floor or walls, only one or two destinations should be used, along with highly contrasting colors.

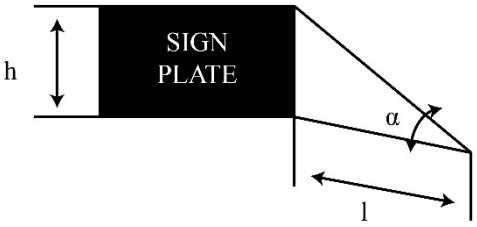
2. **Meaning and consistency in color usage:**
   - Color should be consistent among all signs.
   - Some colors have established meanings that should be considered (like for example yellow for danger or red for prohibition).
   - In lines on the floors or walls, the colors should be used consistently through the setting, and colored bands for decorations that can be confused with the directional lines, should be avoided.

Table 7. Recommendations for Color.

1. **Height, Dimensions and Angle of Vision:**
   - Signage height should always consider the eye level of users.
   - Recommended height between 1.40 and 1.70 m or higher at 1.90 m from the floor.



   - If the signs are to be approached from more than one angle, the use of double or multiple-sided signs (wall-mounted and suspended) to enhance reading from all angles and distances, should be considered.
   - The fact that people can usually distinguish signage within an angle of 30 degrees to both sides without moving their heads should be taken into consideration.
   - The standard ISO/FDIS 3864-1:2001(E) (Standardization, 2001) has a formula to calculate the dimensions that a sign should have according to the distance from which it is expected to be read by users ($h = l / Z$). The image below illustrates the formula:



     where l denotes the distance, h the height of the sign plate, Z the factor of distance that is equal to $1/\tan(\alpha)$ and α is the angular extension of the sign ($\tan(\alpha) = h/l$).

2. **Obstructive Elements:**
   - Columns and other architectural features can block the line of sight to signs.
   - Avoid reflective surfaces that can hinder legibility.

3. **Considerations on mounting locations:**
   - Signs at the entrance help divide the traffic.
   - Signs with small symbols (7.62-15.24 cm): less than 15.24 m apart.
   - Signs with larger symbols (20.32 cm or more): more than 15.24m apart.
   - For permanent information (room numbers), install signs on the wall adjacent to the latch side of the door.
   - Mounted so that a person 2.7 meters away from the sign can read it without any obstructions.

4. **Types of Signage**

DIRETIONAL SIGNAGE:

- Placed in key locations, at or before any major intersection or destinations.
- Use arrows as direction indicators.
- Arrows should be easy to understand and positioned consistently.
- *For Overhead Signs:* high ceilings (2.7432 m or more) large signs with symbols and text should be used. For low ceilings (2.7432 m and below) the signs can be combined with wall signs and maps.
- *ForWall, Pillar,orKiosk Mounted Signs:* Kiosks should have landmarks or symbols to identify them (symbols should be no less than 12.7 to 20.32 cm in height).
- *ForDirectories:* Strategically located, large, and in key locations. Symbols on directories should be between 7.62 to 20.32 cm in height. The relation between destinations and the relevant floor number should be clear. A small gap should be placed between the text and floor number to make it easier to link the information. Same style should be used for all directories.

IDENTIFICATION SIGNAGE:

- Parallel to the wall surface and centered 152.4 cm above the floor.
- For locational signs, the symbols identifying the departments can be enclosed in a contrasting color field in order to stand out from the remaining information. This color field should have a height of at least 15.24 cm height.
- Should be clearly linked with the location to which they refer to.

Table 8. Recommendations for Placement, Dimension and Typology of Signs.

1. **Light Levels:**
   - Light source should not distort colors.
   - Light levels should make the signs legible to most people from a distance of at least 7.62m.
   - Consider brighter interior lighting or lighting the signs individually since it increases sign legibility by improving their contrast with the surroundings.
   - Signs should be well lit (by natural or artificial light) at all times of the day and throughout the year.
2. **Materials, Maintenance and Glare:**
   - Internally lit signs must be well maintained to ensure that the text on the plate remains legible.
   - Use matte finish materials, or a gloss factor of no more than 15% to reduce glare and reflections.
   - When the lighting levels are low, the use of lighter colors for the signage plate background is recommended to increase the legibility of the signs.

Table 9. Recommendations for Illumination, Visibility and Legibility.

1. **Consistency of the signage:**
   - All signs should be related to a common design theme, which means that signs should be consistent and standardized throughout the whole building. If possible, the design should meet the image of the institution.

2. **Norms and Regulations:**
   - The ISO, ANSI, Hablamos Juntos Project and NHS Wayfinding regulations are of interest since these regulations provide recommendations to standardize the signage design, color, and symbols.
     - Other regulations that can be used as a basis for signage development are: http://www.nhsidentity.nhs.uk/; British Standards BS 5378: 1980. Safety signs and colors; BS 5499: 1990. Fire safety signs, notices and graphic symbols; BS 5499-5: 2002. Graphical symbols and signs; BS 8501: 2002. Graphical symbols, and signs, which can be obtained through their website at http://bsonline.techindex.co.uk.
   - References: (Standardization, 2001),(Standardization, 2014),(Association, 2002),(Berger, 2010), and (Department of Health, 2005).

Table 10. Recommendations for Standardization.

1. **User Familiarity with the setting:**
   - Familiarity with the setting can influence the effect of signage.
   - When the signage is changed, some people may be already familiar with the old signs and so they will find the new signage less easy to follow (past recognition can play an important role).
2. **User Diversity:**
   - Population diversity leads to a need of communicating through ways that are universally understandable.
   - Symbols can communicate universally; however, they should be tested among users;
   - Education regarding the symbols may be necessary, thus manuals and instructions can be useful to train users.
3. **Age, Literacy and Cultural Background:**
   - If well-designed, signs can cross the barriers of age, literacy, and cultural backgrounds.
   - For the elderly, signs are better read vertically, with high-contrast, and adequate light.
   - Letters should be as large as possible and with sans serif, or simple serif fonts.
4. **People with visual disabilities:**
   - Use Braille and raised symbols on the signs. Many designers adopt the "double signs" (containing both tactile and visual information).
   - Place them at specific locations and avoid areas with a lot of environmental clutter.
   - Use sans serif fonts that are 13 to 25 mm in size and spaced 7.6 to 203.2 mm apart. Letters that are in upper-case are easier to read for people with visual disabilities.
   - Brailed characters and Pictorial Symbols: Pictograms should be raised by 0.8 mm minimum. Use upper-case letters, sans serif or simple serif, accompanied with grade 2 Braille. Raised characters should be at least 1.6 mm high, but no higher than 5 mm.
5. **Color-Blind People**
   - Color-blind people cannot distinguish colors like red, green, yellow, and light blue – consider the association of symbols.
   - Colors should be carefully chosen, and high contrast between the sign plate and wall should be assured.
6. **Analyze the setting**
   - Volume of people (annual users), user profiles (age, gender, social backgrounds, etc.), and types of services provided should be considered before or during the process of signage design.

Table 11. Recommendations for Inclusivity and User Characteristics.