Approaches in Evaluating Hospital Wayfinding Signage System: A Literature Review

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Abstract

Designing an effective wayfinding system is very crucial in a hospital. Many hospitals in developing countries like the Philippines create increasing pressure on patients when no proper signage is to be followed in times of emergencies. Wayfinding signages aim to provide patients with correct directions without extensive explanations or complex maps. The purpose of this paper is to present a literature review on different hospital wayfinding signage system evaluation methodologies that may be necessary to establish a standard assessment guide. A comprehensive search using Google Scholar is applied to identify initially relevant studies. There is a total of 1, 780 articles identified from the search for the last ten years (2012-2022). The review found a trend in the evaluation of hospital signages, including the types of signages evaluated, design elements considered, and evaluation methods. The conclusion highlights the need for future research to establish methods that consider multiple design elements for improved hospital signage design.

Keywords
Hospital wayfinding signage, design Elements, design evaluation methodology

1. Introduction
Hospital wayfinding signage systems in hospital settings are usually poorly designed particularly due to the expansion of original facilities. Garling, et al. (1986) stated that signage has a significant impact on wayfinding behavior and it must be included in the overall plan arrangement of a structure. Thus, the main purpose of establishing signages is to boost the wayfinding experience of a user (Tang et al. 2009). Another benefit of having a good signage system is time efficiency. It saves time and makes activities easier to complete. As a result, in public facilities, especially those with a significant number of visitors and users, such as hospitals, a signage system is critical (Basri and Sulaiman 2013).

Healthcare institutions like hospitals, according to Bubric et al. (2020), are in the service sector and should deliver the highest quality possible experience to their customers. Furthermore, visitors, like their patients, are generally there for various reasons. Frequently in pain, discomfort, and anxiety. The hospital's complicated wayfinding systems, specifically the signage systems, are one component that adds to the uncomfortable experience that visitors and patients have (Pati et al. 2015). Moreover, the hospital's signage system is a significant component that influences the wayfinding system's effectiveness.

Hospital signage plays a major role in helping hospital users to navigate and arrive at their desired destination. Existing studies have already developed signage design principles, guidelines, and design recommendations that aim to help improve the effectiveness of hospital signage. However, these principles and guidelines are not always considered when designing hospital signages. This poor compliance with standards and guidelines can be attributed to the lack of regular evaluation for hospital signages.

This paper aims to present a literature review on hospital signage evaluation, focusing on the application, design elements considered, and their methods.

2. Literature Review

This section presents relevant concepts in hospital wayfinding signage system.

2.1 Types of Hospital Signages

Several studies formulated classifications for hospital signages. Identification signs, directional signs, and descriptive signs are the three basic types of signs, according to Pollett & Haskell (1979). While on the other hand, Giuliani (2001) added further types of signs, such as destination identification, situation, and object identification, and orientation signs (Helvacolu 2007). For the purpose of this study, the researchers utilized the classification made by the Department of Health of England (2005). Whereas, the types of hospital signage include: directional signs, locational signs, directories, site maps, and safety signs.

2.1.1 Directional Signs

The direction of a destination is indicated by a text message and an arrow on directional signs. Arrows and elevator button panels are used on the majority of directional signs (Giuliani 2001). A directional sign is distinguished from other signs by the presence of an arrow or other directional indicator that indicates which way people should proceed. Other wayfinding aids at your site must be linked to directional signs.

2.1.2 Locational Signs

To identify a location, locational signs are used. They inform others of their location or the fact that they have arrived at their destination. The intended viewing distance and related type size determine the size of the sign, even as they do with directional signs. Locational signs come in a variety of sizes, from small door identity signs to large external locational (fascia) signs that identify main building entrances.

2.1.3 Directories

Most hospital directories are organized by floor, but most people consult the directory to determine which floor they require. As a result of grouping the destinations by floor, people will have to read through several lists of destinations before finding the one they require. Although grouping destinations by floor allows people to see how many floors are in a building and create a mental model of the building by seeing what is on each floor, it makes it more difficult to quickly determine whether a destination is listed.

2.1.4 Site Maps

People must be able to create a simple mental model of the site and its main routes so that they can orient themselves and visualize the route that will take them to their destination using site maps, also known as framed maps. A visitor's wayfinding system relies heavily on framed maps placed throughout the site. A well-designed, framed map can assist site visitors in determining their location and planning the most efficient route to their goal. The ability to find the most direct route is especially crucial for those with disabilities such as limited mobility. While some people find maps simple to use, others find them challenging to comprehend. The effectiveness of a site map must be able to show the similarity between the framed map links to the actual landscape.

2.1.5 Safety Signs

Warnings and safety messages are shown on safety signs, as well as emergency protocols. Evacuation procedures should be established and rehearsed in all healthcare facilities. They are mandated by law to present information to alert people to potential dangers, advise them on essential actions, and direct them to a safe location in the event of an emergency. Most sorts of safety and warning messages have standard signage. Mandatory fire and safety rules ensure that all places, including signage, have proper safety mechanisms. As per the study's basis, standard safety colors, sign shapes with defined meanings, and well-recognized symbols must be used for all safety signs and information to ensure that a clear safety message is conveyed.

2.2 Signage Design Elements

In designing and evaluating hospital signages, different elements are considered. The Department of Health of England (2005), developed best practice considerations for signages in order to improve wayfinding systems in healthcare sites. The following are the design elements that will be considered in this study when determining the compliance of hospital signage.

2.2.1 Typeface and type style

The typeface or typestyle refers to the legibility of the text used in the signage. The typeface has two general categories which are serif and sans serif. Serifs are characterized by the small protrusions that are usually seen at the top and bottom of letters which can be seen in Figure 1.

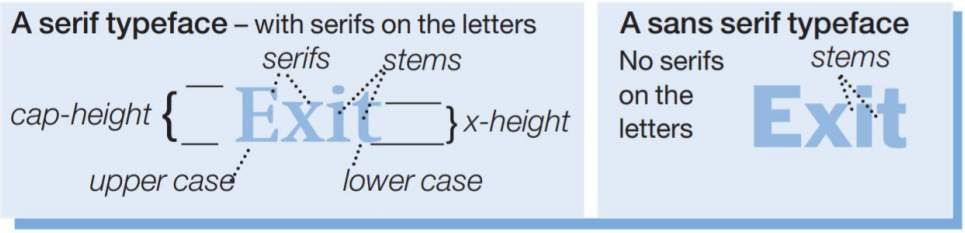

Figure 1. Two Groups of Typeface

Every typeface varies in weight, style, stem thickness, and x-height. The weight of a type can be bold, regular, light, and extra bold. Meanwhile, type styles have three categories which are regular, italic, and condensed style while text styles are categorized into upper and lower case which can be seen in Figure 2 (Department of Health of England, 2005).

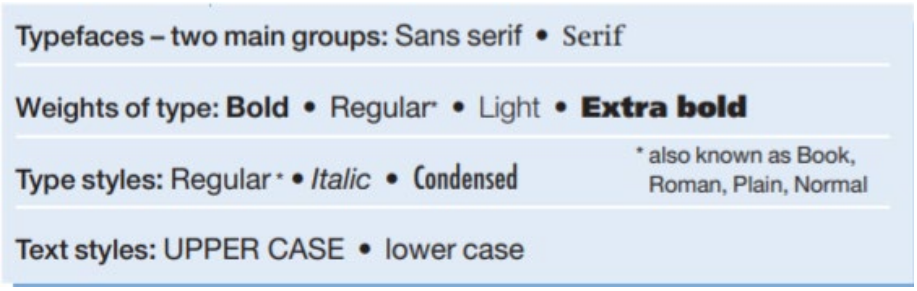

Figure 2. Type styles and Text styles

2.2.2 Type size

Type size refers to the size of the typeface or font that is used in the signages. As mentioned, type size is also a factor that Boonyachut & Sunyavivat (2012) considers for hospital signages due to the elderly and visually impaired site users. Rousek and Hallbeck (2011) also believe that type size is one of the many characteristics that play a role in signage comprehension which greatly affects the usability of the hospital or other healthcare sites. More specifically, variation of type size helps in attracting the attention of site users on certain information that must be emphasized since a large type size can act as an attention-getter.

2.2.3 Text layout and grouping

Information layout and design affect the speed and difficulty of finding the information needed by the people who are viewing the signages. When designing the layout of signage, the following are the factors that must be considered: (1) the type and amount of information; (2) the need for differentiation for different information types such as locational and directional while using a consistent style; (3) signage space availability; (4) quantity of elements to be used such as text, arrows, symbols, and logos; (5) number of color to be used; (6) construction methods considerations of signs such as space limitations, fixings and costs (Department of Health of England 2005).

2.2.4 Text and arrow alignment

From the book of Williams (2015), alignment is defined as the placement of individual items on a page in order to provide unity and information organization. Alignment is concerned with the spatial relation of items within the page (Kasperek 2014). More specifically, it is concerned with the alignment of text and logo as well as the alignment of text with the sign's edges. Alignment is important because everything on signage must be placed purposely in order to visually connect it with the other contents and design elements of signage. With a chosen alignment, a design can

look fun, formal, serious or sophisticated. Moreover, alignment can also help in emphasizing the information hierarchy within signage.

2.2.5 Emphasis on information

In order to emphasize information effectively, the other information that comes with it must be designed less prominently (Martins and de Melo 2014). More specifically, large font sizes can be used to emphasize information since it is considered one of the common ways of attracting site users' attention (Rousek and Hallbeck 2011). Hospital visitors and staff usually need to find specific locations such as the emergency room or comfort room. To emphasize a text, the important information, as well as the information that does not need to be highlighted, must be clearly identified (Department of Health of England 2005). Then, a hierarchy of information must be developed wherein information is listed based on its degree of importance (Martins and de Melo 2014).

2.2.6 Multiple language or dual terms

Rousek and Hallbeck (2011) emphasized that the language to be used in hospital signages should be understandable. Specifically, the study of Sunyavivat & Boonyachut (2013) emphasized that long sentences, abbreviations, or difficult terms should be avoided. This can be attributed to the fact that a big portion of hospital users are elderly while some may not have the capacity to understand medical terminologies and abbreviations. Additionally, some hospital users may also come from foreign countries and are not familiar with the foreign medical terms and abbreviations.

2.2.7 Symbols

Symbols can increase communication (Boonyachut et al. 2012; Leonard, Verster, & Coetzee 2014) and can potentially be a universal language if it is recognized and understood by the viewers in the same way (Department of Health of England, 2005). There are two general types of symbols which are (1) representational symbols that represent the term, object, or facility it represents, and (2) abstract symbols that utilize a non-representational interpretation like a language whose meaning must be learned. The effectiveness of using symbols is usually affected by the familiarity of users, complexity of the symbol meaning, symbol size, positioning, and viewing distance. Moreover, the possibility of confusing the symbol's meaning with another symbol can also influence its effectiveness.

2.2.8 Use of color

The use of color is considered as one of the characteristics of signage that affects comprehension (Boonyachut & Sunyavivat, 2012; Rousek & Hallbeck 2011). Given that a big portion of hospital users are the elderly while some have visual impairments, the adjacent colors used in signage must be significantly different in order to make the type and logo used easier to distinguish from the signage background (Kasperek 2014). Signage visibility is affected by the color contrast between the sign and the sign's environment as well as the contrast between the signage and the text on it (Department of Health of England 2005). The chosen color on signage can either reduce or enhance the noticeability and viewing distance of the sign. There is no single combination of colors that must be used on signs but some are more suited to use than others. When selecting a color, some factors must be considered such as text and background color contrast, eventual fading of colored signages, environment background, number of colors being used, and safety colors to ensure that safety signs will remain prominent.

2.2.9 Positioning of signs

Sign positioning is one of the elements that must be considered when putting up signage. According to Tzeng and Huang (2009), signage that is well-placed helps the site users to arrive at their target destinations with less difficulty and questions asked. Basri and Sulaiman (2013) emphasized the close relationship between sign height and eye level height which has an influence on the level of easy-reading height. Sadek (2005) also recognizes that the signage placement also impacts the user wayfinding along with the signage design.

2.2.10 Methods of construction

Signage construction is one of the factors that must be considered in designing a signage system in hospitals. The study of Tzeng and Huang (2009) highlights that proper construction of signage helps site users to arrive at their destinations easily. Aside from the construction of signages, proper maintenance of the chosen construction must also be done since some changes may cause confusion to site users. Moreover, signage construction is a complex process that considers different materials and various printing processes. According to the Department of Health of England (2005), there are four major types of signage positioning: suspended, projecting, wall-fixed, and post-fixed,. Suspended signages are those that are hung from the ceiling. Projecting signages are usually used in identifying rooms

or departments. Meanwhile, wall-fixed signages can be used internally or externally at any size and can contain any kind of information. Lastly, post-fixed signages are often used outside for locational and directional signs.

2.2.11 Illuminating signs

In designing and positioning signages, lightning must be considered since it can affect the visibility and legibility of signages (Basri & Sulaiman 2013; Foster and Afzalnia 2005). Rousek & Hallbeck (2011) also recognize that changes in sign luminance affect the visibility of a signage. Thus, variations in the levels of natural light in all locations at different times for the whole year must be determined in order to develop the appropriate lightning system (Department of Health of England 2005). An effective lighting system must be able to consider weather conditions, glossy surfaces, sign positioning, and internal illumination. Weather conditions can affect the level of natural light and ultimately the legibility of signages while glossy surfaces of signages can increase the possibility of glare and reflections from the light being utilized in the site.

2.3 Signage Evaluation Methods

2.3.1 Usability Testing

Usability testing is a methodology that allows researchers to observe the users and their interaction with the subject, which in this case is the signage that is being evaluated. Sivaji, Radjo, Amin, & Hashim (2016) conducted a study regarding designing an interactive wayfinding system, utilizing a user experience methodology. The study revealed that the design and development team may improve its hospital wayfinding system by using a user testing approach to better fit the mental model of the users. In connection, Bubric et al. (2020) provided a more extensive evaluation approach for a hospital wayfinding system, outlining key stages of evaluation such as planning, setup, running the session, and debriefing. The lack of specification of the sign design elements to be evaluated is, however, one of the suggested framework's limitations. Although the evaluation questions referenced color, font size, placement, icon use, and language, the particular measures of these aspects were not mentioned, and the researchers mainly focused on wayfinding as a whole. As Bubric and colleagues (2020) found out that signage played a vital role in improving the wayfinding system, Rodrigues, Coelho, & Tavares (2020) performed research on analyzing the user perceptions of the existing signage system in a hospital setting. All of these studies considered the effectiveness of the signage and used the findings from the users to improve its existing wayfinding and signage systems.

2.3.2 Eye-tracking Method

This method involves the use of eye-tracking sensors, which allow researchers to track the duration of fixation and the users' location. Rousek & Hallbeck (2011) evaluated the pictograms and color contrast of the signage in a healthcare setting. They discovered that color contrasts, complexities, and orientations can aid or hinder user comprehension of signage. Cai, Yang, and Tao (2018), on the other hand, developed a new eye-tracking method to evaluate a virtual reality version of an emergency signage system. They created an integrated eye-tracking system for simulating the evacuation experiment using reality applications. They were able to determine the number and location of fixation points and use them to assess whether the signages are visible as a result of this. The characteristics of the planned environment that attract eye fixation during wayfinding were found by Ghamari & Pati (2018). As previously indicated, signage has a substantial impact on effective wayfinding, according to this study. This is supplemented by Ford, Fisher, Paxman-Clarke, & Minichiello (2020). They presented a new eye-tracking approach that measures hospital navigation challenges using mobile eye-tracking. Generally, the eye-tracking method can produce results that are comparable to earlier studies of signage performance using static images in terms of cognitive load and legibility, while eye-tracking technologies give a dynamic tool for the design and placement of signage (Tang 2020).

2.3.3 Survey Method

Another common evaluation method is the survey method, wherein questionnaires are answered by participants regarding the pre and post-experience of using the signages. One variation of the survey method is the Delphi process is a multi-staged survey that aims to reach a general consensus among the participants regarding a topic. Gresham, Taylor, Keyes, Wilkinson, McIntosh & Cunningham (2019) used this method to develop an evaluation framework of signages systems for dementia patients. The output of the Delphi process showed the general perception of the participants on what factors to consider such as the balance between the individuality of patients and universality of signages, aesthetics, and effectiveness, and the placement of the signages with respect to their environment. The other form of survey method is the administering of questionnaires before and after seeing/using the signages. In the study of Keliikoa, Packard, Hansen Smith, Kim, Akasaki & Stupplebeen (2018), intercept surveys were given to pedestrians

and bicyclists to determine whether the signages are visible and helpful in navigating in the area. The survey was conducted 5 months after the installation of wayfinding signages in compliance with the project. Similarly, the study of Basri & Sulaiman (2013) used pre and post-questionnaires to evaluate the effectiveness of the signage height in a public hospital in Hong Kong. The researchers aimed to establish the ergonomically correct signage height by measuring the height and eye level of the hospital staff, patients, and visitors.

3. Methodology

The literature review was carried out using a structured approach similar to the study of Iftikhar, Shah & Luximon (2021). The structured approach is composed of two major parts as follows:

1. Search Criteria

The initial search was conducted in Google Scholar using the keywords: 'hospital signage evaluation', 'signage design evaluation', 'physical', 'healthcare signages', and 'design elements for hospital signage design'. The search is limited to journal articles and review articles which were published for the last ten years (2012-2022).

2. Exclusion Criteria

The following types of papers were excluded from the study:

- Articles with no available full access to the abstract or paper
- Signages evaluated do not fall under the 5 specific types (directional, locational, directories, site maps, warning signs)
- Signage design elements evaluated were not identified.
- The evaluation method was not systematically presented and conducted.

After selecting the articles that were not excluded, the articles were reviewed, and the following information were identified:

- Type Signage Evaluated
- Signage Elements Evaluated
- Method of Evaluation

Keywords used for the initial search task were derived from the current study being conducted by the researchers regarding the topic of hospital signage evaluation. The search task was done using DLSU-affiliated accounts of proponents to enhance the quality of search results. The initial search results were 1,780 articles which were further filtered considering only the keyword 'signage' and excluding articles showing other unrelated articles using the word 'signs'. The researchers found 61 articles that were suitable for the study. After implementing the exclusion criteria, only 38 articles remained. These 38 articles were then reviewed to gather the information needed for the literature review.

4. Results and Discussions

The review of the selected articles showed the trend of the studies on hospital signage design evaluation specifically on the yearly publication, types of signages evaluated, signage elements evaluated, and method of evaluation. Interest in the research topic of hospital signage evaluation was found to vary through the years as shown in Figure 3. The lowest number of publications included in the review was in 2012 while the interest peaked in years 2014 and 2016, while no significant changes in the years 2018 to 2022.

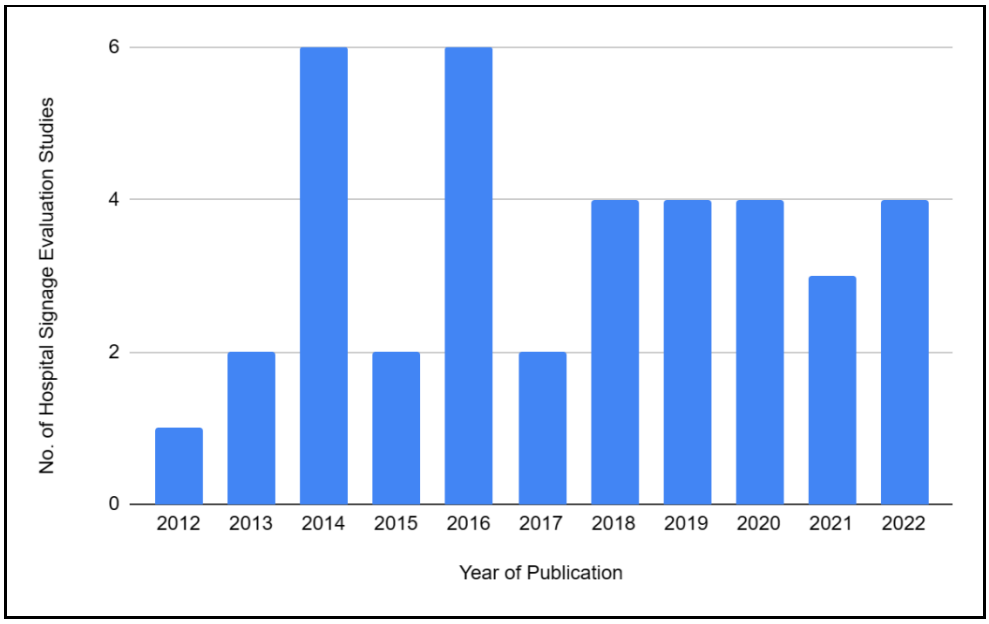

Figure 3. Number of Published Articles per Year

Figure 4 shows the number of published articles based on the type of signage that was evaluated in the studies. From the articles reviewed, the most studied type of hospital signage was directional signage followed by locational signage and directories.

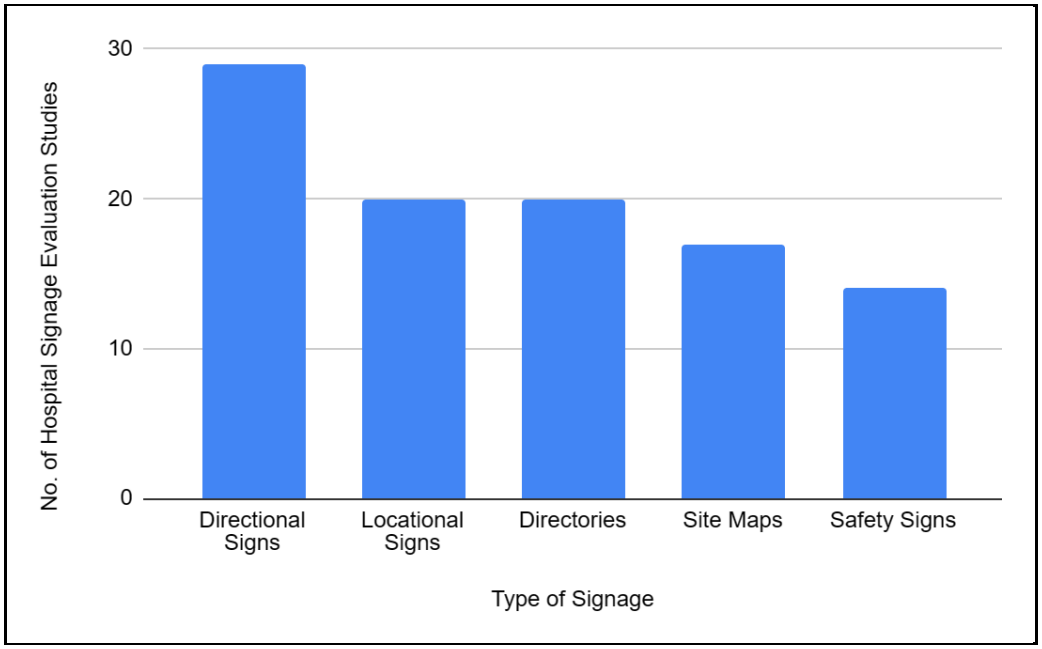

Figure 4 . Number of Published Articles per Type of Signage

Throughout the study period of 2012-2022, the most studied signage design elements are symbols and positioning of signages, followed by emphasizing information as shown in Figure 5. The least studied elements were type size, text layout grouping, and text and arrow alignment.

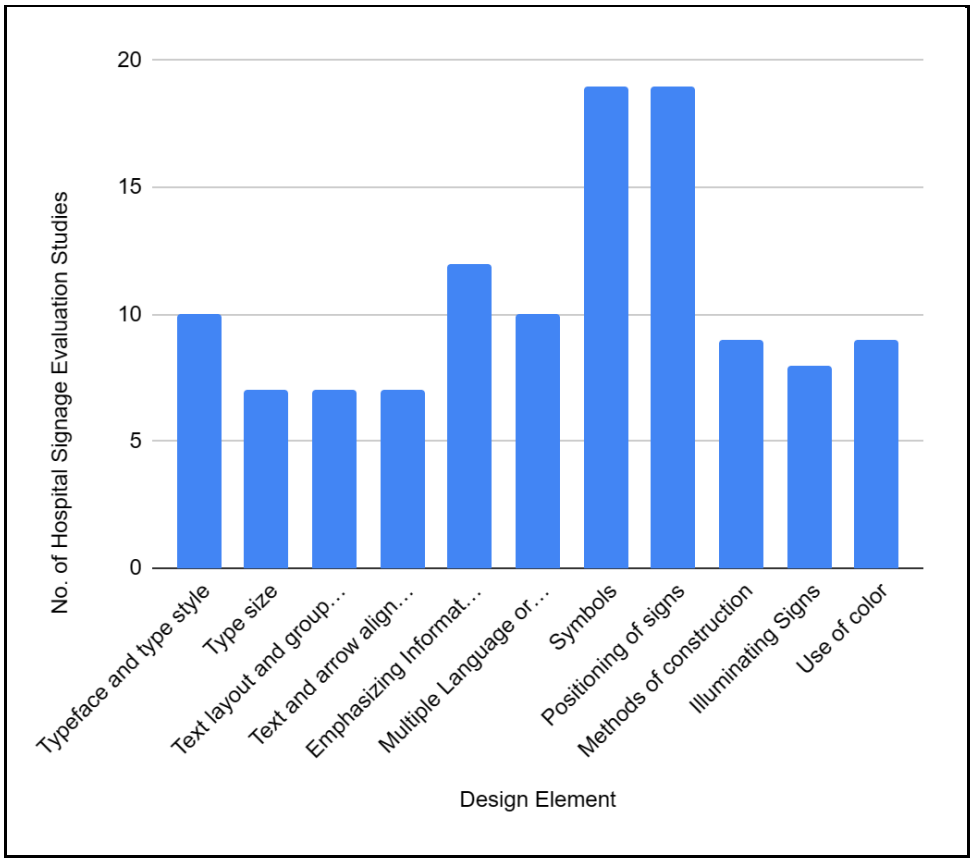

Figure 5 . Number of Published Articles per Design Element

A total of 11 evaluation methods were found based on the articles included in the review. The number of studies per evaluation method is shown in Figure 6. For hospital signage evaluation, the top three most prominent methods were the interview/survey method, usability testing, and simulation, respectively. Some of the articles reviewed used novel approaches for evaluation such as Visibility Testing, Nodal Analysis, Plan-Do-Study-Act, and Accessibility Testing.

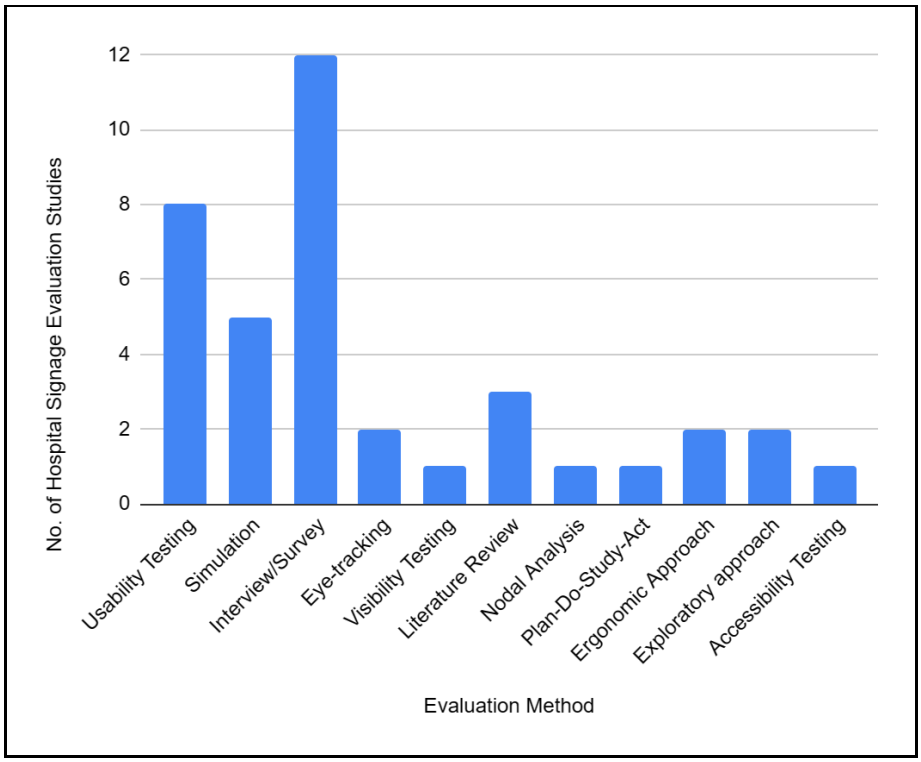

Figure 6. Number of Published Articles per Evaluation Method

5. Conclusions and Recommendations

The concerns of hospital stakeholders such as patients and visitors regarding their wayfinding experience continue to exist. One of the contributing factors to this wayfinding experience is the effectiveness of hospital signages. To continue to improve on the effectiveness, several studies pursued different approaches in evaluating hospital signage considering the different types and different design elements. Due to research limitations, some studies can only consider two or three elements in the evaluation. Because of this, hospital signages are improved only by some aspects of the design but not the whole. This approach only leads the design to myopic improvement which would require future changes as new design elements are evaluated and found to be unsatisfactory. With this, it can be concluded that it is still relevant to establish methods that can consider multiple design elements to provide a more suitable design improvement.

Other areas of study that researchers could explore are the determination of the importance of design elements based on the type of signage, and the further study of other approaches in evaluating signage such as nodal analysis, and the PDSA method. Furthermore, studies may explore the least studied design elements such as type size, text layout grouping, and text and arrow alignment.

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Biographies

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