USE OF EYE LEVEL HEIGHT TO DETERMINE SIGNAGE HEIGHT IN PUBLIC HOSPITAL

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ABSTRACT

Signage provides information and direction. It is important as a medium to show direction in offices and public buildings. Simply implementing signage within facilities, such as hospitals, does not necessarily improve people's way finding experience. Incomplete information and confusion of signage are among common issues being raised by the public to hospital management. This study is carried out to determine user height preferences of Kajang Hospital's signage and to propose an appropriate height for its future signage. 400 respondents participated in this study. They are aged between 18 to 60 years old with the mean of age at 39 years old. Their stature height and eye-level height are measured using SECA Stable Stadiometer. A set of questionnaire is distributed to measure their preferences towards the present signage. The studied signage is also measured using standard measuring tape. The data is analyzed using SPSS. The difference height of the existing signage at the hospital compared to the distribution graph was 68.50 cm (below than 5th percentile), while 115.50 cm (higher than 95th percentile). Suggested range of signage height for Kajang Hospital is 68 cm to 165 cm. The present signage requires necessary height readjustment to be more appropriate for the majority of the users.

Keyword: *ergonomics, eye-level height, signage height, public hospital*

1. INTRODUCTION

Signage, referring to the name and symbol is used to convey messages to specific groups of people. Generally, signage is used for the purpose of marketing strategy, telling directions or a caution for safety purposes. The main purpose of the signs is to communicate, convey information so that recipients can decide based on cognitive information provided. Signage is also considered as one type of mapping system that provides information and direction. It is important as a medium to show direction in offices and public buildings. Incomplete information and confusion of signage are among common issues being raised by the public to hospital management. Design and specification of proper signage is critical in determining its functions.

Visual design or graphics created on signage intended to display information to specific audiences. This is usually expressed in the form of way finding information in places such as streets or on the inside and outside of the building. Since 90's era, signage can be found in all shapes and sizes according to the specific function. Examples of frequently used signage are the billboard signage, road signage, road name signage, signage in the building and parking signage. In fact, nowadays, signage also can be found in electronic or digital display. A digital signage, sometimes known as a digital communications network (DCN), or private plasma screen network, which nowadays consists of screens in a public place showing video and notes of location routes, advertisements, community information, entertainment and news (Dennis et al., 2010).

Signage is important to the visitors of a building and makes them feel more comfortable with their navigating experience (Harkness, 2008). As

a community setting, a public hospital must accommodate an increasingly diverse population, it is critical that signage be provided to be as universally appropriate as possible to fulfill the needs of the users (Salmi, 2007). Kajang Hospital is the one of the busiest hospital that serves more than 3,000 patients annually (Hospital Annual Report, 2014). Increase in patient flow, overworked staff and recent renovations to the hospital have resulted in patients experiencing long wait times, and thusly patient dissatisfaction and stress.

1.1 Problem and Issues

Figure 1.1 : Different Design and Height of Signs in Kajang Hospital.

Kajang Hospital itself received complaints about these problems and confirmed by hospital management itself. This problem and issues acknowledged by Miss Wendy Jitos, the Deputy Director of Kajang Hospital Management. She mentioned that the hospital management is looking forward to improve signage facilities signage in each building at Kajang Hospital since the hospital is already reached over 100 years old. She added that, there is no specific guideline provided to assist the hospital management to improve signage equipment that can meet the criteria required by the users. A large number of signage displayed is seen to be installed with inappropriate specifications which are against users' comfort. Figure 1.1 shows the different design and height of signage in Kajang Hospital. Some signage are placed in a position that is too high, while others are placed in a position that is too low, making it difficult to see due to the fact that they are sheltered from view. From the responses given by the hospital management, the hospital signage require intensive observation and study in order to provide comfort to the user. In fact, determining the positions to install the signs are things that should be taken seriously to ensure the effectiveness of the signage.

1.2 Research Objectives

This study came out with the expected and proposed standard range of signage height that might be appropriate to install an effective signage and provide proper guidelines in determining appropriate height to put signage in Kajang Hospital. The following objectives were established towards achieving the goal;

i. To study the method in standardizing the height of signage.
ii. To recommend ergonomics intervention on signage height range that could be used to improve and satisfy users toward facilities in Kajang Hospital.

2. LITERATURE REVIEWS

Kajang Hospital is located within the district of Hulu Langat, Selangor Darul Ehsan or, to be precise, at the east of Kajang Town. It is a government-funded district hospital about 30 kilometers northeast of Kuala Lumpur. According to the history of the hospital, it was built in the year of 1889. Through its development, in line with the city's and country's developments over time, the hospital could now accommodate to 306 bed from only 250 beds in 1970s. The hospital which built on 16-acre land has gradually increased its number of buildings. In the year 1976 it received an additional 4-storey blocks followed by series of other additional blocks which are the Food Preparation block in 1983, the morgue in 1985 and pathology unit in 1992. In 1999, major improvement to the hospital was completed which was carried out under the Hospital Redevelopment Project Phase 2.

The observation on the morphology of this hospital revealed that it is not a well-planned and well-built hospital. Most of the hospitals nowadays are expected to be planned accordingly to its uses and fuctions as well as the ground and surrounding areas where they are expected to be built. However, as in the case for Kajang Hospital, it is clearly seen that the development of its building was added by phases throughout the years in line with additional new functions.

Signage plays an important role and it is more than just signage (Anthur et al., 1992). Abu Ghazzeh (1997) explained that a 'sign' is used to designate an activity of finding a place in the building on which it is installed. Besides, an advertising sign is a sign that indicates specific products or brands available which includes the symbols and letters that appear to represent the specific identity and information. He also defined that signs represent the most common 'way-finding' aids to the location of goods and services in public building. Signs can be found in many shapes and design according to the place requirement, type of information, and specific function.

Dejonge (1963) has explained that signage can serve to evoke a mental image of the locality in which they are displayed if they are properly arranged with distinctive parts of the signage information system. Meanwhile, Passini (1984) also has noted that way finding is facilitated if signs are readily and accurately perceived.

An old public hospital building is definitely not an exception in the focus of improvement efforts on healthcare facilities, such as way finding system. According to Cowgill and Bolek (2003), it is often seen as an unfriendly place, which causes stress among visitors and the general publics due to the nature of the visits and unfamiliarity of the facility. Based on the Guidelines and Procedures for the Planning of Buildings by Standards Committees and The Cost of The Economic Planning Unit, Prime Minister's Department in Putrajaya (2008), hospital buildings are some of the most important components in providing health services and should be given full concentration in its building coordination.

According to Baumann (2013) in his web (www.designworkplan.com), an effective way finding system depends on human behavior and consists of few basic characteristics: firstly, a signage must be comprehensive, clear and consistently communicate visually with complete message. Then, the information must be relevant to space, location and navigation path. Unnecessary elements must be removed to create a clear visual environment ahead. For navigation purposes, completing the human expectations and building a systematic environment, it is essential to develop a strategic way finding scheme before creating a signage system in a building. In fact, after years, there are still some questions and problems arise even efforts have been taken in improving the signage system in public buildings.

Commonly, signage problems are associated with weakness of graphics or the size of a mere signage, yet the study found other factors that also contribute to the signage system problems, subsequently causing the signs to neglect the purpose of creating them. For example, in signage installation, there are many structural or mechanical aspects to be considered such as material, height, lights and size that are related to the principles of the building. This mechanical aspect of signage is rarely noted by contractors or developers. Therefore, several problems arise, causing the effectiveness of signage system itself distracted.

A study involving emergency signs with three scenarios have been conducted by Tang et al., (2009) to prove that signage does help way finding tasks and the form matters. A year before that, Scialfa et al., (2008) found similar results and concluded that a significant improvement in signage comprehension was discovered when text was added. This case study shows the importance of signage in providing information to users effectively and how to create a systematic physical setting. However, it has been noted by the public that frustration caused by way finding difficulties does not only provoke negative opinions on the physical setting of the structure but it also affects the perception of the public itself and the services offered in that setting (Passini, 1996).

A hospital should not just simply provide signage since the same problems may still occur. Research and proper planning should be conducted to increase way findings. This was supported by Rousek and Hallbeck (2011) that simply implementing signage within facilities, such as hospitals, does not necessarily improve people's way finding experience. For that reasons a number of improvement have been made to solve the signage issues. Increasing the contrast of arrows, enlarging the area of the sign and changing the aspect ratio of the sign may increase the maximum distance at which effective identification can be attained (Collins, 1991).

In addition, Foster and Afzainia (2005), found that both signage design and illumination conditions affect the visibility of signage. The size, abstract concept, luminance and the interactional effect of visual angle are all need to be considered in signage design. Similar regulatory information were suggested by Muhlhausen (2006) in achieving effective graphic communication, such as establishing consistency in sign placements and graphic layouts, coding areas by using color and memorable signs, using easily understood "plain" language and using established pictographs with color and words to facilitate comprehension of written messages on the signage.

Healthcare signage is widely used internationally to communicate with different languages, disabilities and ages, however, typically results in confusion and even anger (Cowgill and Bolek, 2003). They have concluded that the signage confusion among the users will increase in the future due to constant expansion of hospitals. This expectation has also been agreed by

some medical personnel. In the meantime, nurses also felt that there was too much signage within hospitals and that caused the users became immune to the signs and may not have paid attention to all of the meanings (Dykes, 2009).

3. MATERIALS AND METHOD

3.1 Methods

Descriptive study approach was used in investigating this study, which means that all collected information were used without changing the environment. According to Edgar and Manz (2017), a descriptive study focuses more on specific cases of some systems involving a one-time interaction with groups of people, which also known as cross-sectional study. This involves the interaction between researcher and participant in surveys or interviews to collect the necessary information on the signage height. There was identification of signage attributes based on the semi structured interviews done in the pilot test. The respondents were selected based on purposive sampling method.

During the early stages of the study, a pilot test comprising general observation and interviews were conducted in Kajang Hospital to study the real situation and the problems occurred. This process took three days. A number of categories and factors were identified, which may help in proving the main problems contributing to inappropriate position of the signage in this hospital.

3.2 Methodology

A pilot study containing a field observation and interviews were purposely conducted in this study to understand the chosen study area and to investigate the suitability of the area with the study needs. This is also to improve the research design and data collection techniques, which will later establish a relevant research design that could prove the final findings. This pilot study was carried out in February 2012. By conducting the pilot test, the factors that could contribute to hospital signage problem were identified, which affected the way of finding system in Kajang Hospital. Based on the study done by Calori and Vanden-Eynden (2016), method for defining sign type that can give impact on human function is by physical characteristics and communication function. In fact, physical characteristics of signage such as placement and height have a very strong significance to be part of facilities improvement in the hospital.

A field observation conducted by the researcher which involved personal observation on Kajang Hospital. In this process, photographs and personal notes were made on the attributes of existing signage, pattern of activities and impression about the place. This observation indicated the suitability of the study area, basic understanding on the study area including the signage factors and users' activities.

In this pilot study, the respondents were purposely selected based on their willingness to participate after reading the consent letter. This conversation was recorded with the permission from the respondents. Additionally, semi structured interviews were conducted with the Deputy Management Director of Kajang Hospital, Miss Wendy Jitos. This is to gather information on the current issues concerning the study area including the hospital signage installation procedures, ISO guidelines and standards, authorities and the strategies to fix the current problems. This will help in establishing the research problems and will benefit in future development recommendation at the end of the study.

This study used a quantitative approach focusing on the results from a large number of people instead of individuals. In fact, there were many compiling statistics, opinion surveys and questionnaires involved in this study. Therefore, to determine the relevant number of data, the sample size was calculated. The sample size of the study was determined according to the total population of Kajang by considering the tendency of frequent users and visitors of Kajang Hospital. The population data was specified in https://www.know.cf/enciclopedia/tab/ms/Kajang/ stating the number of Kajang population of about 342,657 people comprising various races (60.4% Malays, 19.3% Chinese, 9.7% India and 10.6% other ethnic groups). From this data, the sample size of the study was determined using the formula proposed by Cochran (1977).

To determine the sample size, some studies were carried out on population and sampling method. Population can be defined as a set of people at the location where the problem existed. The study employed purposing sampling method. This sampling technique can effectively help in exploring anthropological situations where the discovery of meaning can benefit from an intuitive approach. Besides, this technique is one of the most cost-effective and time-effective techniques.

$$n_o = \frac{n_o}{(1 + n_0/N)}$$

$$n_o = \frac{(t^2)(p)(q)}{d^2}$$

$$n_o = \frac{(1.96^2)(0.5)(0.5)}{0.05^2}$$

$$n_o = \mathbf{384.16}$$

t = 1.96 – value t for α = 0.05 and the population N ≥ 60 (Barlet, 2001)

p and q = 0.5 – maximum ratio that may obtain the maximum sample size

d – an acceptable margin of error for the estimated = 0.05

Kajang Population, N = 342,657

$$n = \frac{n_o}{(1 + n_o / N)}$$

$$n = \frac{384.16}{(1 + 384.16 / 342,657)}$$

$$n = \frac{384.16}{1 + 0.00112112}$$

$$n = \frac{384.16}{1.00112112}$$

$$n = 383.73$$

$$n = \underline{384 \text{ respondents}}$$

Figure 2: Sample Population Calculation

This calculation was used to find the number of samples for this study, which obtained 384 respondents involved in this survey. However, this study has increased the number of respondents to 400 to have a good response rate in producing accurate and useful results, which consist of 200 males and 200 females with the mean age of 39 years old. All respondents were included in one set of sample group to represent all users in Kajang Hospital such as patients, visitors and staff or outside workers who attend the hospital. All of selected respondents were all above 18 years old respondents and were ensured normal and did not suffer from any disability that may affect their eye level height.

A questionnaire is designed and initiated by reviewing the study objectives, which define the indicators and variables involved in the study. The study aims to obtain information proving that the height of signage at the Kajang Hospital should be adjusted according to the users' eye level height in achieving quality ergonomics and that both of these are affecting each other. The developed questionnaire in this study consists of four sections with a total of 23 questions. In general, every section has its significant purpose in collecting information and respondents' review. In addition, it recognizes the respondents' criteria considered by the researcher to determine the results based on minimum age range, local citizen, specific ethnic and address of their current residential place.

One of the important sections in the questionnaires is the signage factors. In this section, it consists of seven questions on how the criteria of signage might satisfy the users of Kajang Hospital. The respondents were asked on their satisfaction towards signage system and to mark their level of satisfaction according to the scales given; Scale 1 (extremely disagree) to Scale 10 (extremely agree). From the provided scales, respondents' satisfaction was determined.

The data collection process conducted in three selected areas which were completely provided with chairs and some other facilities for those who wait for their turn to be called. As clearly shown in Figure 3 below, these three strategic spots connect most of the walking path way in the hospital between the routes used by the hospital staff to walk to other departments. The three selected spots are specialist clinics (Figure 4), physiotherapy waiting area (Figure 5), and the hospital pharmacy (Figure 6). However, users in other area of interests were also approached based on their availability and willingness to participate. It took approximately three months to complete all the process.

Figure 3: The Hospital Map

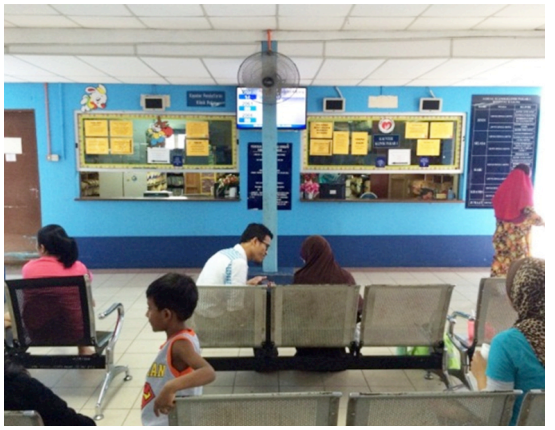

Figure 5: Specialist Clinics of Kajang Hospital (2)

Figure 4: Specialist Clinics of Kajang Hospital

Figure 6: Physiotherapy Unit of Kajang Hospital (Rehabilitation)

Figure 7: Physiotherapy Unit of Kajang Hospital Rehabilitation)-(2)

Figure 8: Pharmacy of Kajang Hospital

3.3 Materials

In this study, signage height and the respondents' eye level height in Kajang Hospital were measured using the height measurement appliances known as the Measuring Tape and SECA217 Stable Stadiometer, which were chosen due to their specifics of reading that can produce accurate data. Measuring tape is one of the most utilised tools in home improvement as well as many work environments. In fact, it is compact, portable and easy to use.

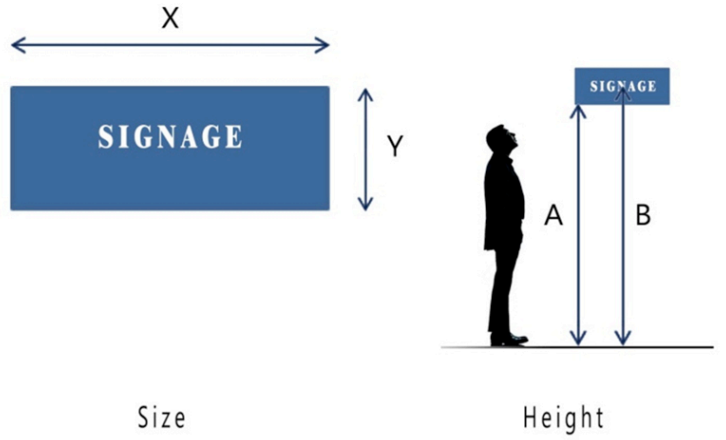

Figure 9: Signage Measurements

The measurement data are based on four items;

X : the length of signage (cm)
Y : the width of signage (cm)
A : the height of the bottom side of signage to the floor level (cm)
B : the height of the centre points of the signage to the floor level (cm)

Unit of measurement used is centimetre. Measuring tape (shown as Figure 10) is flexible and easy to be used as it can be resilient. In fact, it is similar to a normal barometer that allows the measurement of length to be easily done apart from being portable. The hook slides back and forth on the tape to measure either by the boundaries of the tape on the signage or by hooking it on the edge of the signage. Sliding motion was used to ensure that the signage measurements are accurate in any direction.

Figure 10: Standard 8 Meter Measuring Tape
Source: www.google.com.my/imgres

Figure 11: Process of Measuring Signage Height

The signage measuring process involved 10 selected signage located at significance areas mostly used by the users to find ways. In these 10 locations of signage, the measuring process was done by three members of the study. The signage measurements were recorded.

Figure 12: Signage height in Hospital Kajang

Meanwhile, SECA 217 Stable Stadiometer (as shown in Figure 11) was cleverly designed with assembly system and particularly high-quality materials that easily and effectively allow the measurement of respondent's stature height. Apart from that, it is almost similar to a permanent installation and has exceptionally high degree of stability. In addition, the adjustable spacer on this measuring tool ensures a secure hold without any fittings. In fact, it is highly trusted in terms of safety. When disassembled, the stadiometer is easy to be transported and brought to other locations. The body height presents the perpendicular distance between the top of the head (the vertex) and the bottom of the feet (Popovic S., et.al, 2013), whereas the eye level height refers to the height of eyes from the bottom of the feet.

Both of these heights can be measured using SECA217 Stable Stadiometer with the respondents standing upright against it. Basically, respondents are required to put their feet together and stand straight against the wall until their heels touch the bottom of the stadiometer upright. Meanwhile, their buttocks and upper part of their back should also touch the stadiometer upright while their head does not have to touch the stadiometer. Respondents' head is expected to be in the Frankfort horizontal plane (parallel to the floor). This can be achieved when the lower edge of the eye socket (the orbitale) is horizontal with the tragion. The vertex is the highest point on their head, otherwise the respondents have to raise or lower their chin until it is in the Frankfort horizontal plane to properly align their head. This position is important in obtaining an accurate reading of the respondents' stature height and eye level height. Figure 12 shows that, these measuring steps and protocols were referred from a guideline attached in Interviewer Measurements of UK Measurements Protocols (NDNS P2751).

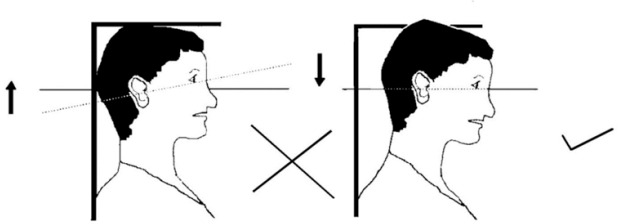

Figure 13: Frankfort Plane – Adults
Interviewer Measurements of UK Measurements Protocols (NDNS P2751)

SECA 217 Stable Stadiomater is functionally well in getting the data of respondents' stature height and eye-level height. This measuring tool has an adjustable spacer, which ensures a secure grip without any fittings. It is also suitable for medical practices in hospital. In fact, this stadiometer is easy to be carried anywhere when disassembled. The measuring scale on the machine is 20 - 205 cm.

Figure 14: SECA217 Stable Stadiometer
Source:http://www.seca.com/english/uk/home/products/details/seca/

Figure 15: The Process of Measuring Stature Height and Eye Level Height

Figure 15 shows the process of measuring the height. There were two types of height to be measured; Stature Height and Eye Level Height, which clearly shows in Figure 16. After completing the reading, respondents were asked to step away from the stadiometer. Reading was recorded in centimetres (cm) and millimetres (mm). When the measurement falls between two millimetres, it was recorded to the nearest even millimetre. The data were directly put in SPSS and were analysed according to the statistic test to obtain the results for the study.

Figure 16: Stature Height and Eye-Level Height

This stadiometer measuring range is around 20 – 205 cm. The graduation is 1 mm, while the dimension is 328 x 2,145 x 574 mm. It is mostly suitable as a mobile research tool. The weight of only 3.6 kg makes it easy to be carried anywhere. Furthermore, the collapsible height measuring rod of the stadiometer can be put together quickly and simply in just a few steps and attach to a stable platform. There is no need to attach the rod to the hospital building wall. It is easy to step onto the large base plate, which has no raised sides or edges.

4. RESULT AND DISCUSSIONS

Relevant data were analysed in advance demography respondent crystallising the characteristics of the respondent who was involved in the study at the Kajang Hospital. It involved the process of developing theories and relating the relevant facts to determine the signage height. Statistical Package for Social Science (SPSS) applications was used to analyse the data by calculating the number of samples, demography, eye level height and the percentage of answer scales given by the respondents against the questions asked via questionnaire. The main focus in data analysis is to disclose information showing the level of appropriateness of the signage height in Kajang Hospital in the form of numbers.

Throughout the study, there are two variables that consistently involved until the end. These variables were categorized into two types of variables. The first type is known as eye-level height. The eye level height explains the required range of height appropriate in installing the signage. The eye-level height was determined based on the natural physical height among the respondents and the target group of samples. Meanwhile, the other variable of the study is signage height. The signage height depends on the required criteria demanded by the users due to ergonomics principles.

Each data was analyzed based on the descriptive method, cross tabulation and correlation. In Descriptive, the data were explained to understand the characteristics of data. In Cross Tabulation or Contingency Table (Chi-Square Independent Test), the relationship between the variables was determined. It also helped in showing the relationship between the height of signage and level of ergonomics for the signage.

Table 1 shows the information from the measurement of selected signage existed in Kajang Hospital. Each measurement was calculated using the measurement unit of centimetre. In total, there were 10 signage chosen with different criteria and location.

Table 1: Signage Measurements in Kajang Hospital

Signage No.	Location	X	Y	A	B
		the length of signage (cm)	the width of signage (cm)	the height of the bottom side of signage to the floor level (cm)	the height of the centre point of signage to the floor level (cm)
1	Specialist Clinics	76 cm	38 cm	190.7 cm	210.6 cm
2	Paediatrics	190.1 cm	30.2 cm	90.8 cm	110.6 cm
3	Walkway to Pathology	120.2 cm	90.2 cm	130.5 cm	180.8 cm
4	Walkway to Klinik Sejahtera	40.6 cm	20.5 cm	20.5 cm	210.5 cm
5	Pharmacy	30.5 cm	20.5 cm	130.5 cm	140.5 cm
6	Walkway to Diagnostics	61.5 cm	31 cm	190.5 cm	210.1 cm
7	Management Office Building	102 cm	40.1 cm	230.8 cm	250.8 cm
8	Library of Specialist Office	90.2 cm	30.1 cm	270 cm	280.5 cm
9	Emergency	120.3 cm	50.1 cm	230.3 cm	260 cm
10	Parking Area	105 cm	42.5 cm	45 cm	68 cm

Based on Table 1, Measurement B was used as the measurement of signage height. Therefore, the highest measurement of signage was referred to Signage No. 8 (280.5 cm), whereas the lowest signage was referred to Signage No.10 (68 cm), which located at the hospital parking area. From the data, the height range of existing signage in Kajang Hospital could be determined. The existing signage height at Kajang Hospital is ranging from 68 cm to 280.5 cm, which suggests an obvious difference among the signage height in the hospital, and the mean of existing signage height is 174.25 cm.

Other than height, the size of hospital signage has no uniformity. However, this would not be the focus of the study and can be considered as the limitation of the study. The height adjustment is strongly required to standardize the signage height accordingly to eye level height. Hence, this would achieve users' convenience in finding their way through signage.

The selected signage were displayed on variety of location, position and height. This collected data on signage height were clarified by the respondents' review on questionnaires.

Table 2: Respondents' Review on Signage Height in Kajang Hospital

Review By The Respondent	Frequency	Percent (%)
Very Low	6	1.5
Low	7	1.8
Slightly Low	12	3.0
Moderate Low	64	16.0
Moderate High	72	18.0
Slightly High	68	17.0
High	94	23.5
Very High	52	13.0
Extremely High	25	6.3
Total	400	100.0

The chart above demonstrates the number of respondents classified according to the review given towards the height of signage at Kajang Hospital. Result from the analysis obtained suggests that the respondents tend to say that the signage in the hospital are high. Nonetheless, there are also respondents saying that the signage provided in the hospitals are lower from the preferable height. In fact, Table 2 shows 23.5% people who agreed that most signage in the hospital are located at high position. In some minor cases, respondents also agreed that several signage at the hospital were installed at such a low height as shown in Figure 17.

Figure 17: Low Signage in Kajang Hospital

Figure 17 shows one example meant by some of the respondents as being too low. This signage is located in front of the car parking area where parked vehicles blocked the signage in that area. According to some of the respondents, the signage should not be hidden like this as it would mislead the visitors to put their cars when they are in an emergency and in need of finding a car park. As the parking space at Kajang Hospital is very limited with the width of the road that is also very small, the ability of viewing the signage would be reduced. In fact, the hospital will face traffic problem at the parking area during peak hours. This situation troubles the users when they have to rush to get treatment or to visit patients in the hospital.

Figure 18: High Signage in Kajang Hospital

Figure 18 presents two signage in a walking way at the Kajang Hospital building. Both of them were positioned up to 190 cm high and are difficult to be read. In fact, their size is too small and difficult to be seen from 5 metres distance. To read the information displayed, the users need to move to a short distance and look up to the signage when they walk through this path.

To measure the relation between signage height and review by the respondents, Table 2 was used to identify the significance of both data. It was discovered that the existing signage range in the hospital is from 68 cm to 280.5 cm. This can be associated by referring to Table 3 below.

Table 3: Number of Respondents Based on Group of Eye Level Height

Group Name	Respondents' Eye Level Height (cm)	n	%
A	129.6-139.5	52	13.0
B	139.6-149.5	126	31.75
C	149.6-159.5	135	33.5
D	159.6-169.5	81	20.25
E	169.6-179.5	6	1.5
	Total	400	100.0

The highest frequency of respondents came to the hospital based on group of height is 135 respondents, which was from Group C. This was followed by 126 respondents from Group B and the least respondent group was from group E. Based on the study, the lowest eye level height among the respondents is 130.5 cm with the highest being 174.0 cm. Therefore, the average of respondents' eye level height is 151.34 cm, and this average eye level height will used to compare respondents preference to determine the appropriate height of signage.

Table 4: Statistics Data on Respondents' Standing Eye Level Height

Statistics		
Respondents' Standing Eye Level Height (cm)		
N	Valid	400
	Missing	0
Mean		151.3353
Median		152.1500
Mode		147.30[a]
Lowest Height		130.5
Highest Height		174.0
Percentiles	95	164.9950
Percentiles	5	136.50
Multiple modes exist. The smallest value is shown.		

The value of mean in Table 4 shows a value of 151.34 cm with a small value of 9.31 for standard deviation. This data shows that there was no obvious difference among the respondents' eye level height. Based on this data, a graph on significant relationship between the respondents' eye level height and the existing hospital signage height can be illustrated in Chart 4.3.

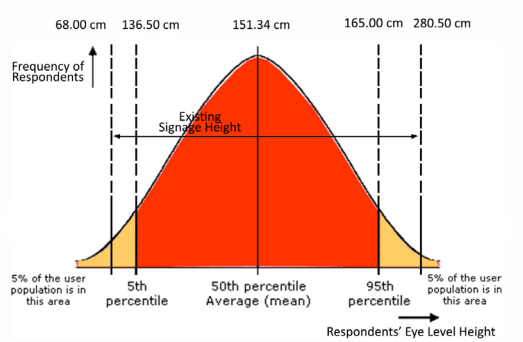

Chart 1: Distribution Graph of Respondents' Eye Level Height towards Existing Signage Height Range

According to Chart 1, the information on respondents' eye level height was used to determine the 95th percentile at 165.00 cm while the 5th percentile was at 136.5 cm. There was difference in height between the existing signage heights in the hospital compared to the height range statistically calculated to determine the proposed signage height range. The difference in height of the existing signage at the hospital compared to the distribution graph is 68.50 cm (below than 5th percentile) and 115.50 cm (higher than 95th percentile).

Table 5: Group of Respondent based on Their Review on Existing Signage Height.

Type of Review	Group Eye Level Height (cm)					Total	Category
	A	B	C	D	E		
Very Low	0	3	0	2	1	6	89 respondents, (Lower than their ELH)
Low	1	0	4	2	0	7	
Slightly Low	0	5	4	3	0	12	
Moderate Low	1	4	29	27	3	64	
Mean of Existing Signage Height (174.25 cm)							
Moderate High	1	13	31	27	0	72	311 respondents, (Higher than their ELH)
Slightly High	2	28	27	9	2	68	
High	9	51	25	9	0	94	
Very High	24	14	13	1	0	52	
Extremely High	14	8	2	1	0	25	
Total Respondents	**52**	**126**	**135**	**81**	**6**	**400**	

Based on Table 5, there were several respondents who said that the hospital signage was very low, while other respondents said that the hospital signage are displayed at a very high range of height. These data clarified the findings stating that the signage at the Kajang Hospital did not have any standard range of height, thus causing different dissatisfaction among users. The

uncoordinated height of signage in this hospital can be visualised through the data obtained in Table 5. Hence, the signage in Kajang Hospital were categorised into two categories namely low signage and high signage.

Based on the table above, 311 respondents mentioned that the signage in Kajang Hospital is higher than their eye level height. Meanwhile, 89 respondents mentioned that the signage in the hospital is lower than their eye level height. In addition, the readings in recorded in two type of categories. The first category consisted of 72 respondents (Moderately High), 68 respondents (Slightly High), 94 respondents (High), 52 respondents (Very High), and 25 respondents (Extremely High), meanwhile, in another category, 64 respondents (Moderately Low), 12 respondents (Slightly Low), 7 respondents (Low), and 6 respondents (Very Low). Most of the respondents agreed that signage at the Kajang Hospital are higher than their eye level height. This finding shows that majority of the users were short and they have lower eye level height.

All of this data was compared to the value of height calculated based on the 5th and 95th percentile to determine the appropriate height range for the hospital signage according to users' preference and average of respondent's eye level height. As general, this study will be supported by two major findings; 1) The range of height suggested in Chart 4.3 is between 5th percentile and 95th percentile, which referred to 136.5 cm to 160.5 cm, and 2) The majority number of respondents have agreed that signage at the Kajang Hospital are mostly higher than their eye level height.

By obtaining the range of respondents' eye level height, the height of the proposed signage was suggested. Signage height can be determined based on some considerations. Ergonomics-Info.com stated that an ergonomic aspect of appropriate height to be viewed comfortably is according to the height of eye level. There are some examples of item such as a monitor screen, notice board or signage that must be installed at the proper height to fit the users' horizontal line of sight and preferred view area. Figure 4.3 depicts the proper position of users' eyes to see in a comfortable way, which meets the ergonomic design.

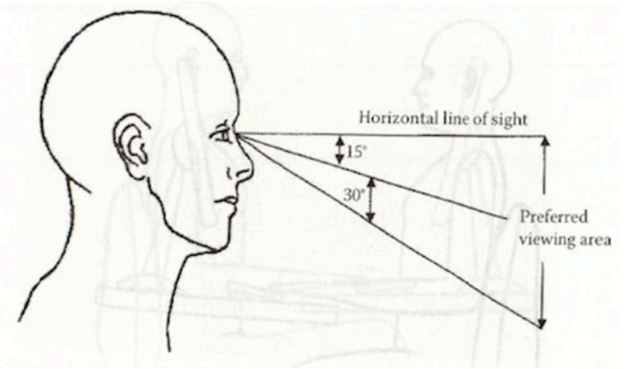

Figure 19: Preferred Viewing Area (http://www.ergonomics-info.com/ergonomic-monitors.html)

Figure 19 shows that preferred viewing area of normal human that stated and publish by www.ergonomics-info.com/ergonomic-monitors.html.Throughout the data analysis, the study found that the mean of respondents' eye level height in Kajang Hospital is 151.34 cm. In fact, this mean was used to determine the height range of the signage specifically. The height range of signage would be the alternative to determine the suggested range of height that is practically effective for several respondents with different of eye level height to be used as a reference for signage installation in the future. Based on the study, Figure 19 shows the illustration of preferred viewing height range of normal signage users of Kajang Hospital. The study has found that most preferred viewing area must be at the same height of eye level and below.

Figure 20: Range of Signage Height in Kajang Hospital based on users preference

From the data obtained, inappropriate connection between the data from the study compared to the height of existing signage proved that there are problems that occurred regarding the signage installation in Kajang Hospital. The present signage height in this hospital can be adjusted to appropriate position of height proposed by this study as a reference for the hospital management. Meanwhile, the respondents' eye level height can be referred as a determinant for the appropriate height range to install the signage at Kajang Hospital. This data is relevant where it shows the height range from the lowest level and the highest for placing the signage.

5. CONCLUSION

This study was conducted to propose a guideline to standardize the signage height for Kajang Hospital. This study has reviewed the issues and problems concerning the average daily user's urgency affecting the effectiveness of signage at the Kajang Hospital. The data were collected and analyzed to identify the output of this study. Each finding was later described with supported explanation based on results obtained in SPSS.

On the other hand, the strength of this study was supported by the information on the users' eye level height at the Kajang Hospital. This information was used to identify and associate signage height problems with the principles of ergonomics, which was neglected in the installation of signage in this hospital. With these significant outputs, the recommended range of signage height was obtained.

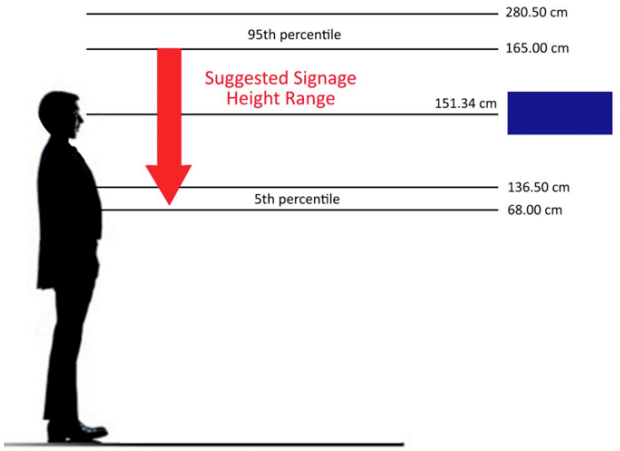

Figure 21: Suggested Signage Height Range for Kajang Hospital

The study had selected 95% people to use the hospital signage based on the suggested height range and picked the 95th percentile value of anthropometric graph. This has allowed the average height of people or the 5th percentile ones to be able to look at the signage at the maximum height, which is based on the value of 95th percentile. Therefore, the highest (maximum) height to install signage in Kajang Hospital is 165.00 cm with the lowest of 68 cm based on the lowest (minimum) eye level height of the respondents. Hence, the final range of signage height that can be implemented in Kajang Hospital is 68 cm to 165 cm as illustrated in Figure 21.

This study has defined the height for signage, which is expected to minimise the discomfort of users and reduce the forces acting on their eyes and body. The present signage in Kajang Hospital require necessary height readjustment to satisfy the staff and visitors. Improvement is vital to ensure that the signage meet the directional purpose. The general concept of ergonomics height for the signage refers to the comfort of the users' eyes to look at the signage installed within the range similar to the height of their eye level. Besides, the signage height adjustment in Kajang Hospital can be targeted as part of treatment and prevention of neck pain and can reduce Musculoskeletal Disorders risk factors, allowing a more efficient and pain-free work. This can be accomplished by reviewing several factors involving human factors and signage-related factors. Therefore, the final range of signage height that can be implemented in Kajang Hospital is from 68 cm to 165 cm.

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