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ORIGINAL ARTICLE

Mapping Breast Cancer Research in Malaysia: A Scientometric Analysis

TENGKU MUHAMMAD H[1], JUHARA H[2,3], WAN FAIZIAH WAR[3,4], WAN NOR A[5], NUR INTAN RAIHANA R[6], ROSNI A[6], KAMARUL IMRAN M[1*]

[1]Department of Community Medicine, [2]Department of Radiology, [4]Department of Pathology, [5]Unit of Biostatistics and Research Methodology, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia
[3]Breast Cancer Awareness & Research Unit, Hospital Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia
[6]School of Computer Sciences, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia

ABSTRAK

Kajian ini bertujuan untuk memberi gambaran tentang penyelidikan kanser payudara yang telah dijalankan di Malaysia. Kajian ini juga bertujuan untuk mengenal pasti trend penyelidikan kanser payudara di Malaysia. Kami telah mengumpulkan 343 makalah yang berkaitan daripada pangkalan data Scopus. Seterusnya, kami telah menyingkirkan satu makalah duplikasi dan dua makalah yang tidak menepati kriteria kajian kami. Selanjutnya, analisis bibliometrik dan analisis kata kunci sohor kini telah dijalankan ke atas 340 makalah yang selebihnya. Kajian ini mendapati kadar pertumbuhan tahunan bagi penyelidikan kanser payudara di Malaysia adalah 7.4%. Kebanyakan makalah dalam bidang ini ialah makalah kajian dan mempunyai beberapa orang penulis. Penulis yang paling produktif ialah Yip CH yang telah menghasilkan 69 penulisan makalah, manakala Universiti Malaya merupakan universiti yang paling aktif dalam bidang kajian ini di Malaysia. Kami juga mendapati dalam tempoh lima tahun terakhir, tiada tema yang dominan dalam bidang penyelidikan kanser payudara di Malaysia. Kendatipun begitu, dua kluster kajian yang berkaitan dengan kanser payudara di Malaysia yang semakin popular ialah analisis data perubatan dan perubatan kepersisan yang berkaitan dengan kanser payudara genom. Kesimpulannya, penyelidikan kanser payudara di Malaysia berkembang dengan baik, meskipun ada beberapa penambah baik yang diperlukan. Pengurusan sumber yang baik amatlah diperlukan kerana dana dalam bidang kajian ini adalah terhad.

Kata kunci: aktiviti kajian, bibliometrik, kajian, kanser payudara, Malaysia

Address for correspondence and reprint requests: Associate Professor Dr. Kamarul Imran Musa. Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, 16150 Kelantan, Malaysia. Tel: +609-767 6622 / 6621 / 6633 Email: drkamarul@usm.my

ABSTRACT

The purpose of this study was to provide an overview of breast cancer researches in Malaysia. Besides, this study aimed to identify the trends of breast cancer research in Malaysia. This study retrieved 343 related publications from the Scopus database. After removing one duplicated publication and another two publications that did not meet the study criteria, the remaining 340 publications were analysed using a bibliometric analysis and trending keywords analysis. This study found that the annual growth rate of publications was 7.4%. The majority of the publications were research articles and multi-author. The most productive author was Yip CH with 69 publications, and the University of Malaya was the top institution in Malaysia related to this research area. For the last five years, there were no dominant themes in this research area. However, this study found two emerging clusters of breast cancer research in Malaysia, which related to medical data analytics and precision medicine in genomic breast cancer. Overall, breast cancer research in Malaysia is progressing towards a positive side, though a few improvements are needed. As the funding in this research area is scarce, proper allocation of the resources is needed.

Keywords: bibliometrics, breast cancer, research, research activities, Malaysia

INTRODUCTION

Breast cancer is the commonest cancer in Malaysia, and it affected 34.1/100,000 Malaysian populations in 2019 (Abdul Manan et al. 2019). This statistic was almost similar to the South-East Asian statistic in which 34.8/100,000 people were affected by this cancer (Fan et al. 2015). In terms of breast cancer mortality, Malaysia had the highest age-standardised mortality rate among South-East Asian countries in 2012 (Yip 2016). Despite the concerning statistics, public awareness about breast cancer was relatively low (Lee et al. 2022; Mohamad & Kok 2019).

Scientometrics covers various quantitative approaches and is used to assess scientific literature productions and their practices (Leydesdorff & Milojevi 2015). Bibliometrics, a subset of scientometrics, provides a set of analyses to assess the research output of any research area. The bibliometric approach had been used to gauge the impact of the research area by evaluating the related researchers and publications within the field (Cobo et al. 2011). The main advantage of scientometric analysis is that it can assess an unlimited amount of publication in any field of study. Thus, this quantitative approach provides insight into general publication patterns, which is beneficial for the researchers in the research area.

This study aimed to provide an overview of research activities on

breast cancer in Malaysia in terms of the distribution of publications and journals, top authors and institutional collaborations. Also, this study intended to identify the trend of breast cancer research in Malaysia.

MATERIALS AND METHODS

DATA EXTRACTION AND COLLECTION

All scientific publications related to breast cancer research in Malaysia were retrieved from the Scopus database on 24th May 2021. The following query was used: (TITLE ("breast cancer" OR "breast carcinoma" OR tumour AND breast OR tumor AND breast OR "mammary cancer" OR "ductal carcinoma" OR "invasive carcinoma" OR "breast mass" OR "breast lesion" OR "breast malignancy") AND TITLE-ABS-KEY(malaysia)) AND (LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "cp") OR LIMIT-TO(DOCTYPE, "re")) AND (LIMIT-TO (LANGUAGE , "English"))

The searched outputs were limited to the English language and the type of documents was restricted to research articles, conference papers and reviews. Metadata, title and abstract for each article were downloaded in BibTeX file format.

STATISTICAL ANALYSIS AND SOFTWARE

Data cleaning and data management were done using R software version 4.1.0 (R Core Team 2021). Data were checked for duplicate using the title and the DOI number. There were one duplicated publication, one response letter, and one case study. Thus, the three publications were removed from the data. Figure 1 presents the flow of analysis in this study. Additionally, the R code and data for the analysis were available in the author's GitHub repository (https://github.com/tengku-hanis/bilio-bc-Malaysia).

Descriptive Bibliometrics

Bibliometric analysis was done using a bibliometrix package (Aria & Cuccurullo 2017). Bibliometric analysis was used to describe the distribution of publications in terms of authorship, journal, and institutional collaboration. Bradford's law of scattering was used to describe the distribution of papers across the sources (Vickery 1948), and to determine the core journal in this study. The papers were divided into three zones. Each zone contained a relatively similar number of papers,

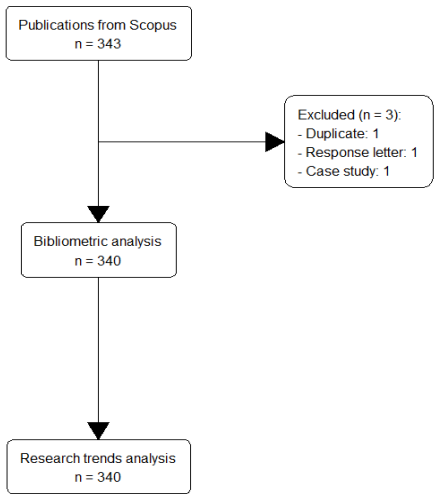

Figure 1: The flow of the analysis in this study.

while the number of journals increased as the number of zones increased. Bradford's law of scattering was estimated through the bibliometrix package.

Research Trends

Research trends were evaluated using a thematic map and trending keywords analysis. Both analyses were implemented through the bibliometrix package. Thematic map or strategic theme was proposed by Cobo et al. in 2011. The author's keywords which were extracted from the metadata of the database were used to construct the thematic map. Only the top 100 keywords with a minimum appearance of eight were included in the analysis to identify the thematic clusters.

Trending keywords analysis used the author's keywords retrieved from the Scopus database. Keywords with a minimum frequency of two from the publications between 2010 and 2020 were included in the analysis. Only the top five keywords for each year were displayed in the plot.

RESULTS

DESCRIPTIVE BIBLIOMETRIC RESULT

After removing three publications, there were 340 publications, ranging from 1982 to 2021 included in this study. The publications consisted of 312 research articles, 21 review papers and 7 conference papers. Additionally, Chan (1982) authored the earliest publication related to breast cancer research in Malaysia.

Main Characteristics of the Included Studies

The average citation per document was 15.8, and the range of citations was between 0 and 244. There were 8 single-authored papers, while the remaining 332 publications were multi-authored papers. The annual

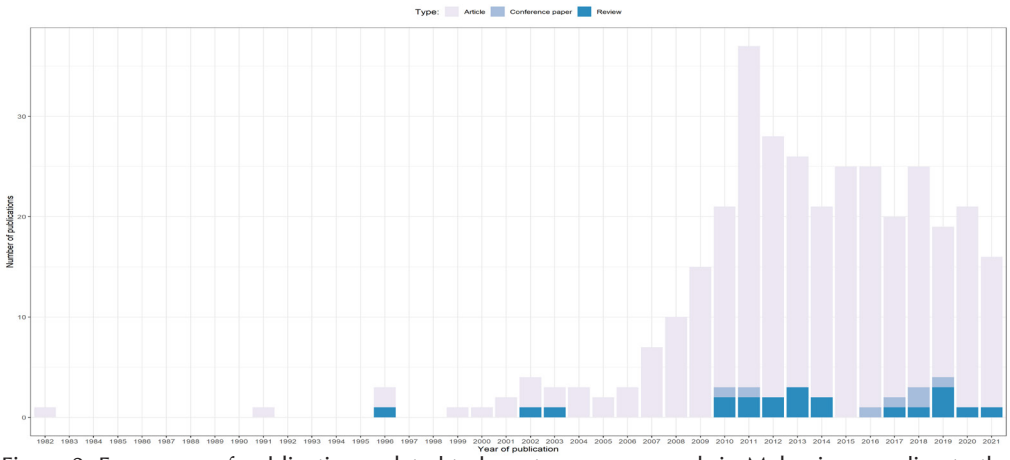

Figure 2: Frequency of publications related to breast cancer research in Malaysia according to the year of publication.

percentage of the growth rate of publications was 7.4%. Figure 2 shows a distribution of publications according to the year of publication. About 21.8% of publications were funded and the remaining 78.2% were not funded. Additionally, the number of authors per publication ranged between 1 and 26 and about 57.9% of the publications in this study had 3 to 6 authors.

Distribution of Authors

There were 1,222 authors involved in publications of breast cancer research in Malaysia. Yip CH was the top author with 69 publications related to breast cancer research in Malaysia ranging from 1996 until 2019, followed by Taib NA and Taib NAM with 56 and 21 publications, respectively. Figure 3 presents the top 10 most productive authors over time, taking into account the total citation per year on top of the number of articles published.

Distribution of Journals

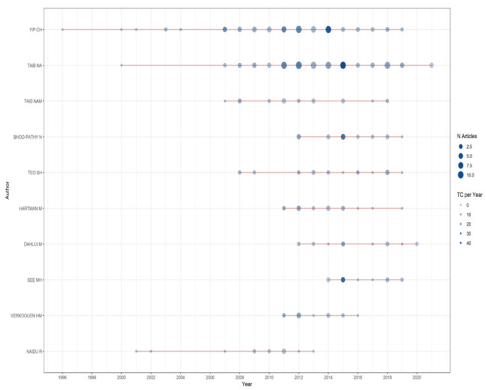

Figure 3: Top 10 most productive authors over time in the publication of breast cancer research in Malaysia.

Table 1: Core journals in breast cancer research in Malaysia.

Journals	Rank	No. of papers (%)
Asian Pacific Journal of Cancer Prevention	1	67 (19.7)
PLOS One	2	12 (3.5)
World Journal of Surgery	2	12 (3.5)
Medical Journal of Malaysia	4	9 (2.6)
Singapore Medical Journal	4	9 (2.6)
Malaysian Journal of Medical Sciences	6	7 (2.1)

There were 146 journals related to breast cancer research in Malaysia. The six core journals published 34.1% of papers out of total publications in this study. Table 1 showed the list of all core journals involved in related publications, while Table 2 presents a zone of journals according to Bradford's law of scattering.

Institutional collaborations

About 360 institutions were involved in breast cancer research in Malaysia and was summarised in the institutional collaboration plot in Figure 4. However, only the top 20 institutions were displayed in the plot. Additionally, node degree reflected the number of connections each institution had, which is reflected by

Table 2: Zones of journals related to breast cancer research in Malaysia.

Zones	No of journals	No of papers
Zone 1 (core journals)	6	116
Zone 2	40	112
Zone 3	112	112

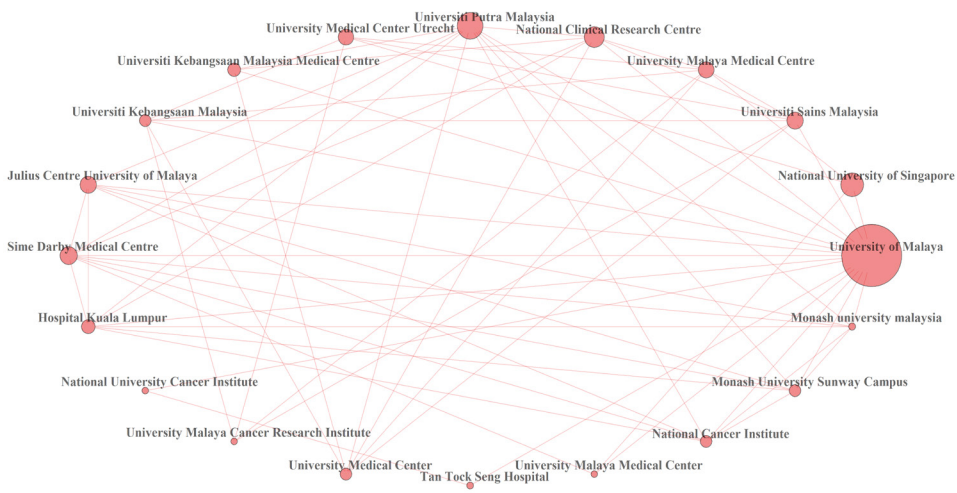

Figure 4: Collaboration among the top 20 institutions related to breast cancer research in Malaysia.

the size of nodes in Figure 4. The most active institution in the research area was the University of Malaya with a node degree of 345, followed by the National University of Singapore (148), Universiti Sains Malaysia (132), Universiti Malaya Medical Centre (116) and National Clinical Research Centre (100).

RESEARCH TRENDS

Thematic clusters

Figure 5 presented 11 clusters of breast

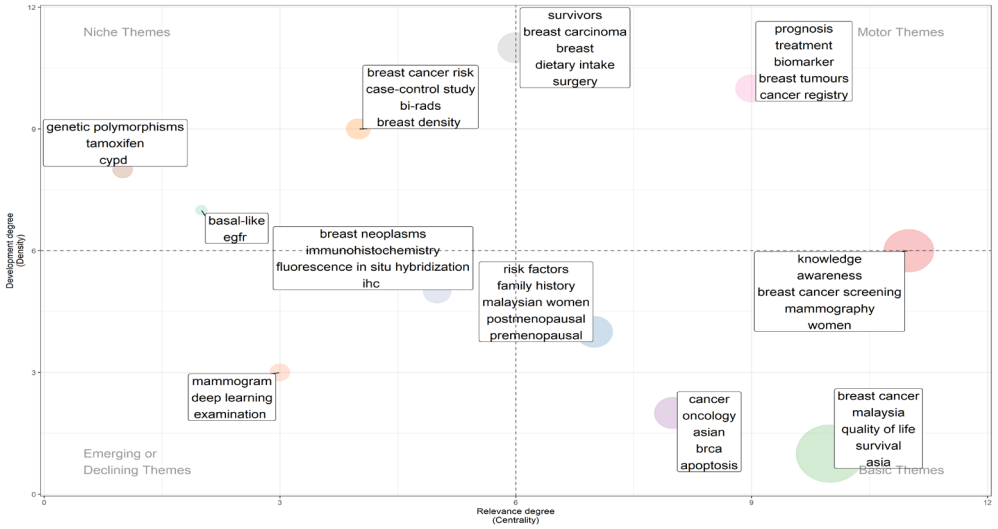

Figure 5: Thematic map of breast cancer research in Malaysia. cypd=cytochrome P450 2D6 or CYP2D6, egfr=epidermal growth factor receptor, bi-rads= breast imaging reporting and data system, ihc= immunohistochemistry, brca=breast cancer gene.

cancer research in Malaysia. The upper-right quadrant represented a motor theme, and the lower-right quadrant represented basic themes. Additionally, the upper-left quadrant reflected niche themes, while the lower-left quadrant represented emerging or declining themes. The most frequent keywords were used to represent each cluster. There was one cluster in the motor themes, three clusters in the basic themes, three clusters in the niche themes and two clusters in emerging themes. Additionally, there were two in-between clusters, one cluster between the motor and basic themes and another one between motor and niche themes.

Breast cancer research related to prognosis, biomarker and cancer registry were the most developed and central research area in Malaysia. However, research areas related to family history, risk factors, quality of life, and survival of breast cancer patients reflected basic themes of breast cancer research in Malaysia. Research clusters in this theme had been studied for a long time and were once a central research area in breast cancer research in Malaysia. As shown in Figure 5, there was one in-between cluster that had become less central in breast cancer research in Malaysia.

The three clusters in the niche themes may indicate a highly developed and isolated research area. However, the clusters in this theme may migrate into a motor theme as one in-between cluster was observed between the niche and motor themes. Thus, the research clusters in niche themes may become a central research area of breast cancer in Malaysia in future. Additionally, there were two emerging clusters related to breast cancer research in Malaysia. Researches related to deep learning and mammogram rose in popularity, while research related to immunohistochemistry (IHC) and fluorescence in situ hybridisation (FISH) had also showed an emerging trend.

Trending Keywords

Table 3 presents the top author keywords for publications in breast cancer research in Malaysia. Breast cancer research in Malaysia which related to awareness, quality of life, patient's survival and risk factors was starting to increase an established research domain. These keywords coincided with research clusters in basic themes in Figure 5.

Figure 6 illustrates trending keywords in breast cancer research in Malaysia for the last 10 years. The most prevalent keyword was 'immunohistochemistry' and 'breast neoplasm spanned' from

Table 3: Top author keywords for breast cancer research in Malaysia

Author keywords	Frequency
Breast cancer	179
Malaysia	56
Knowledge	15
Quality of life	12
Survival	12
Asia	11
Awareness	10
Chemotherapy	9
Polymorphism	9
Risk factors	8

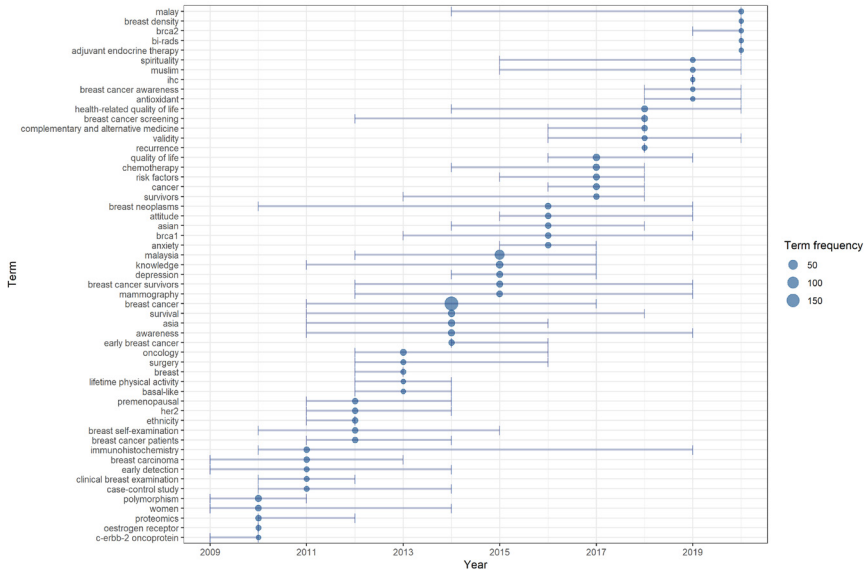

Figure 6: Trending keywords for breast cancer research in Malaysia between 2010 and 2020.

2010 to 2019. Nevertheless, among the 145 keywords included in Figure 6, none of the keywords had a frequency above 50 except for 'breast cancer' and 'Malaysia', which did not give much insight into the trend in this research area. All the remaining keywords had a frequency lower than 20. Thus, for the last 10 years, there was no dominant research area in breast cancer research in Malaysia.

DISCUSSION

Based on the Scopus database, the earliest publication related to breast cancer in Malaysia was in 1982. However, publications in the early years were scarce. Starting in 1999, the breast cancer publications in Malaysia, which the highest was in 2011 with a total of 37 publications. The annual growth rate of publications in breast cancer research in Malaysia was higher than the annual growth rate of cancer publications globally which were 7.4% and 6.5%, respectively (Begum et al. 2018). However, about 63.8% of the total papers were published in the last 10 years, while the previous 40 years only made up about 36.2% of total papers. A large number of publications in the last 10 years indicated the research activities in this area were active and were moving in the right direction.

Breast cancer researches in Malaysia showed a good collaboration between academic institutions, medical centres and government bodies. Besides, this study found that researchers in this area had a close collaboration with Singaporean institutions such as the National University of Singapore and the National University Cancer Institute (Figure 4). Despite a good collaboration between various institutions in Malaysia and abroad,

only 21.8% of total publications had financial support. The lack of financial support may hinder the growth of research activities in this area, especially in advanced study such as genetic research which requires funding and good facilities.

The main domain of breast cancer research in Malaysia was related to the quality of life, disease management including chemotherapy and surgery, risk factors and breast cancer development which included researches in apoptosis and breast cancer gene. Most of these research themes were still prevalent in the previous 10 years as identified in Figure 6. In the last five years, these research themes were evolved by exploring new sub-themes. Researches related to breast cancer management started to study sub-themes such as adjuvant endocrine therapy (Choo et al. 2019; Saiful Bahri et al. 2021), and complementary and alternative medicine (Chui et al. 2018; Khan & Jacob 2017; Mujar et al. 2017; Zulkipli et al. 2018). Additionally, researches related to the quality of life explored the religious and spiritual aspects of breast cancer patients (Pahlevan Sharif et al. 2021; Pahlevan Sharif & Ong 2019).

Based on the thematic map analysis, there were two emerging clusters. The first cluster was related to IHC and FISH. Researches related to IHC had been quite popular in the last 10 years as shown in Figure 6. The publication related to this keyword spanned from 2010 to 2019. The popularity of this keyword may indicate the rise of precision medicine or genomic breast cancer research in Malaysia. Currently, the use of precision medicine is limited to human epidermal growth receptor 2 and metastatic triple-negative breast cancer (Lim et al. 2019). Another emerging cluster was related to mammograms and deep learning. There were two papers that used deep learning for breast cancer detection (Ismail & Sovuthy 2019; Makhtar et al. 2020). The use of deep learning should be extended to various medical imaging such as tomosynthesis, ultrasound and magnetic resonance imaging. Future research should not only focus on breast cancer detection but extend the application of deep learning to risk assessment and prognosis of the disease. Both research clusters require resources in terms of funding and good facilities. Lacking any of these resources may decelerate the advancement of these research clusters.

This study explored the use of bibliometric analysis coupled with thematic map and keywords analysis to provide an overview of breast cancer research in Malaysia. This data-driven approach was the main advantage of this study. The main limitation of this study was it only included a Scopus database. Each database has its metadata structure which makes it difficult to include different databases in a single comprehensive analysis. Although the Scopus database is extensive, there is a possibility of missing publication that is only available in other databases. However, it should be noted that the purpose of the bibliometric analysis is to provide a big picture of scientific

research activities and evaluate their performance (Patra et al. 2006). This study further expanded this objective by seeking the research trends of this research area. Additionally, the finding of this study was limited to breast cancer research in Malaysia which were published before the collecting data date.

CONCLUSION

This study presents a structure of breast cancer research in Malaysia. The finding of this study offers an insight about the future direction in this research area. Breast cancer research has shown to be a promising research area in Malaysia as it promotes good collaboration between various agencies and good support in terms of expert availability. However, lack of financial support may delay the advancement in this research area. Nonetheless, the findings of this study may help in directing future work and promoting resource allocation in breast cancer researches in Malaysia

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