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## Lessons from Indonesia, a country with highest COVID-19 mortality rate in the world: dissecting multiple aspects [version 1; peer review: awaiting peer review]

Muhammad Miftahussurur, Camilia Metadea Aji Savitri, Langgeng Agung Waskito, Yudith Annisa Ayu Rezkitha, Inge Dhamanti, Diah Indriani, Bagong Suyanto, Raissa Virgy Rianda, Yoshio Yamaoka

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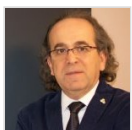
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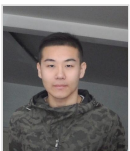
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## REVIEW

# Lessons from Indonesia, a country with highest COVID-19 mortality rate in the world: dissecting multiple aspects

[version 1; peer review: awaiting peer review]

Muhammad Miftahussurur<sup>1,2</sup>, Camilia Metadea Aji Savitri<sup>2</sup>,  
Langgeng Agung Waskito<sup>2,3</sup>, Yudith Annisa Ayu Rezkitha<sup>2,4</sup>, Inge Dhamanti<sup>5-7</sup>,  
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**V1** First published: 10 Aug 2022, 11:920  
<https://doi.org/10.12688/f1000research.111285.1>

Latest published: 10 Aug 2022, 11:920  
<https://doi.org/10.12688/f1000research.111285.1>

## Abstract

COVID-19 has been infecting every continent and Indonesia had suffered greatly as it ranked first for confirmed cases in Southeast Asia region with almost 100,000 deaths. We summarized Indonesian population demographic, socio-behavior, multiple government policy and public health interventions contributed to the high mortality. Although the virulence of COVID-19 strain was found to be similar as other countries, it might be inaccurate due to the low amount of sequenced genome and publicly accessible data of the virus' strain. As Indonesia recorded higher testing number than WHO's target, there were imbalances of testing capacity between capital cities and remote areas, hence the actual case number would be larger. The availability of healthcare facilities and skilled healthcare workers were also dispersed unequally, causing Indonesian health systems near collapsing. Moreover, individual sense of urgency and hazard of the pandemic were low, as shown by the low compliance of wearing masks and social distancing. Even though Indonesia was unprepared early in the pandemic, currently these systems are being improved.

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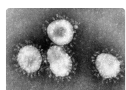
Indonesia has experienced an extensive problem in conquering the pandemic, hence, the country needed a comprehensive approach from the government, citizens, even private sectors to cease the pandemic.

### Keywords

COVID-19, intervention, disease burden, mortality



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**Author roles:** **Miftahussurur M:** Conceptualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Savitri CMA:** Formal Analysis, Writing – Original Draft Preparation; **Waskito LA:** Formal Analysis, Writing – Original Draft Preparation; **Rezkiha YAA:** Data Curation, Writing – Original Draft Preparation; **Dhamanti I:** Data Curation, Writing – Review & Editing; **Indriani D:** Data Curation, Writing – Original Draft Preparation; **Suyanto B:** Formal Analysis, Writing – Review & Editing; **Rianda RV:** Data Curation, Writing – Original Draft Preparation; **Yamaoka Y:** Conceptualization, Writing – Review & Editing

**Competing interests:** No competing interests were disclosed.

**Grant information:** This study was supported by Top-Tier COVID-19 grants from Universitas Airlangga. Number 1035/UN3.14/PT/2020. *The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

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**How to cite this article:** Miftahussurur M, Savitri CMA, Waskito LA *et al.* **Lessons from Indonesia, a country with highest COVID-19 mortality rate in the world: dissecting multiple aspects [version 1; peer review: awaiting peer review]** F1000Research 2022, 11:920 <https://doi.org/10.12688/f1000research.111285.1>

**First published:** 10 Aug 2022, 11:920 <https://doi.org/10.12688/f1000research.111285.1>

## Introduction

Coronavirus disease 2019 (COVID-19) had been declared a pandemic by World Health Organization (WHO) on January 30<sup>th</sup> 2020. It kept spreading worldwide, despite different continents separated by oceans.<sup>1</sup> Few coronaviruses came with mild symptoms, upon exception was severe acute respiratory syndrome coronavirus (SARS-CoV) which infects more than 8,000 people in China during 2002-2003 and Middle East respiratory syndrome (MERS) coronavirus (MERS-CoV) in 2012, infected 2494 people and claimed lives of 858 in Saudi Arabia.<sup>2</sup>

Worldwide confirmed cases was a staggering 196 million with more than 4 million deaths.<sup>3</sup> Indonesia held second position only to India in Southeast Asia. Last known confirmed cases were more than three million alongside almost 100,000 deaths. With numbers growing every day, Indonesia's case fatality rate (CFR) had reached 2.8%, higher than worldwide which is 2.2%. The CFR had been worse early in the pandemic, reaching 9% on April. COVID-19 infection had claimed myriad of lives, from the tip of Sumatera through remote islands of Molucca and Papua.<sup>4</sup>

Host, agent, and environment interactions were crucial in the progression of infectious disease. Therefore, high mortality rates should be dissected from multiple aspects.<sup>5</sup> Epidemiological assessment may be relevant to understand the patterns of transmission.<sup>6</sup> From host side, it has been a mystery whether population characteristic and behavior contribute to the continuation of the disease. The recognition of disease's contributing factor might give an insight to government policies. With better policies, countries would be able to control one variable in infection management. In this review, we will discuss COVID-19 infection in Indonesia thoroughly, from its genealogy, demography, to health policies and capabilities of healthcare resources. Some information will be our original investigation. These data support our hypothesis regarding the reason behind the worse condition in Indonesia.

## Prevalence and distribution across provinces

Among Southeast Asia nation countries, Indonesia was leading for confirmed cases.<sup>7</sup> Indonesia had crossed the one million mark on January 26<sup>th</sup>, 2021. Daily addition of confirmed cases ranged around 30,000 cases, currently around 30,000-40,000.<sup>4</sup> Highest record of new confirmed cases of 56,757 people had been reported on July 15<sup>th</sup>. Moreover, Indonesia had the highest deaths of almost 100,000 people.<sup>8</sup> As of August 1<sup>st</sup> 2021, Indonesia had more than 3.4 million confirmed cases with more than 500,000 active cases.<sup>4</sup> Currently, the case progression is soaring.

The distribution of cases varied across the country. With 34 provinces and population of 240 million, each province had different demographic, infrastructures, and socioeconomic conditions. Jakarta, the capital city of Indonesia held most cases of more than 260,000, followed by West Java, East Java, Central Java, and South Sulawesi. The capital counted 2,487 cases per 100,000 people, the highest in the country. On the other hand, East Java held first position for deaths of 7,805 people (6.92% deaths out of all confirmed cases).<sup>9</sup> It seemed higher case number did not align with higher population; even though larger population made more potential hosts for the virus,<sup>10</sup> since Jakarta was not the most populated city. However, it is the province with the highest population density of 16,704 people per km<sup>2</sup>, therefore, with higher density and mobility, is a promoting factor for COVID-19 transmission.<sup>11</sup>

Studies from India<sup>12</sup> and Algeria<sup>13</sup> concluded that case number grew as urban density climbs. Provinces in Indonesia had different result, nevertheless. There were few provinces with higher cases amidst less population density and vice versa. This paradox could stem from the uneven availability of diagnostic tools in some areas, while many lived in remote ones. Even though Indonesia had tested more than 300,000 people,<sup>14</sup> almost half originated from Jakarta alone. This phenomenon revealed testing imbalances in other 33 provinces. Moreover, there were vague sources whether the number stands for one person-one testing or one person tested more than once. Therefore, adequate availability of diagnostic tools across country to equalize testing coverage is essential. Adequate diagnosis would help isolate and contain the disease.

## Genealogy and viral mutation

The SARS-CoV-2 genome is a single stranded positive-sense RNA.<sup>15</sup> This virus has ~30Kb in size, 38% of GC ratio and composed of 13-15 open reading frames (ORFs). It has 11 protein-coding genes with 12 expressed proteins among the constructed ORFs. The ORFs arrangement is very similar with SARS-CoV and MERS-CoV.<sup>16,17</sup> It is arranged as replicase and protease (1a-1b), followed by major S, E, M and N protein in a typical 5'-3' order. These protein products play an essential role in pathogenesis, attachment, fusion, and survival in host cells.

Recent universally-used classification methods for SARS-CoV-2 are Nextstrain,<sup>18</sup> GISAID<sup>19</sup> clades and PANGO lineages.<sup>20</sup> Both Nextstrain and GISAID described a broad-brush characterization of globally available databases, whereas pangolin lineages aimed at the outbreak sources in a dynamic manner.<sup>20</sup> The latter grant access to create variants based on several occurred mutations, currently referred as Variants of Interest (VOI) and Variant of Concern (VOC) by WHO and CDC. VOCs had evidence to high transmissibility or virulence with reduction of neutralization

ability through vaccination or natural immunity and evade detection. The VOI solely reported as genetic marker that might be correlated to some characteristic that VOC has, with evidence of increased case proportion.<sup>21</sup>

Indonesian SARS-CoV-2 had currently deposited 2,549 genomes in GISAID. Indonesian SARS-CoV-2 had VOI of Eta (5 genomes), Iota (2 genomes) and Kappa (2 genomes). As for VOC were Delta (382 genomes) and Alpha (49 genomes). The Delta variant or B.1.617.2 lineage were predominantly found especially in sequences submitted after April 2021. It is characterized by spike mutations of T19R, G142D, Δ157-158, L452R, T478K, D614G, P681R, and D950N.<sup>22</sup> The prime feature of this variant is its high transmissibility, potential reduction in neutralization by some EUA monoclonal antibody and potential post-vaccination immunity reduction.<sup>23,24</sup> Therefore, Delta might be responsible for Indonesia's current second wave, as it is also reported as the main cause of second wave in India.<sup>21</sup> Alpha variant, first emerged in England, is the second most predominant in Indonesian SARS-CoV-2. It is characterized by seven missense mutations (N501Y, A570D, D614G, P681H, T716I, S982A, D1118H) and three deletions in spike (69/70del and 144del).<sup>22</sup> Therefore, dissemination of these variants in Indonesia might be due to the lack of international travel restrictions.

The accelerated number of sequenced viruses is essential for genome surveillance to understand circulating viruses in population. However, it only covered for less than 1% of total cases in Indonesia. As the available genome sequencing equipment are centralized in capital cities, the tiny proportion of virus collected might lead to the misinterpretation of current circulating virus. Therefore, increased availability of genome sequencing equipment or divergent distribution for viral DNA transport across country is crucial.

### Socio-behavioral factors

COVID-19 had brought substantial changes on how people lived. One underlying factor was the perceived the risk of getting infected.<sup>25</sup> Moreover, proper knowledge of COVID-19 and awareness for WHO recommendations were equally essential.<sup>26</sup> Case numbers in Indonesia are proliferating, owing to not only multiple violations of preventive measures, but also a lack of social construct of COVID-19 to begin with. Some even concluded COVID-19 as a harmless disease.<sup>27</sup>

Since there is no definitive treatment available, the government had implemented multiple preventive measures. However, data from the Indonesian government stated that only 29% of all cities nationwide had >90% docility to wear masks. Restaurants were the primary place where people do not wear masks, followed by private housing and public places. The social-distancing compliance also had similar results with gym, home, and tourist attractions as places where people do not socially distanced.<sup>28</sup> This phenomenon can be attributed to the lenient implementation of these measures, complemented by the lack of knowledge and awareness. On the contrary, a study of a student population in China found that 75% considered wearing masks when going outside is beneficial for themselves, even when the pandemic is over.<sup>25</sup>

Studies have found health behavior to be influenced by perceived severity and susceptibility of COVID-19.<sup>29-31</sup> One study found older people regarded themselves as more susceptible to the disease,<sup>30</sup> while other study found older people worried less than younger ones.<sup>32</sup> Awareness to the disease was more emphasized by highly educated people. Older and educated people lean more towards comply with precautionary measures.<sup>30</sup> In addition, adherences to precautionary measures were found to be correlated with trust in the government, probably due to the validity of information they have given.<sup>33</sup> Indonesians had low confidence in the government in COVID-19 management, which might be the reason why there was low compliance on preventive measures nationwide.<sup>34,35</sup> As fear of the disease is associated with motivation of engaging to behavioral change,<sup>36</sup> broadening the sense of crisis and awareness of COVID-19 are imperative, with the expectation of increased awareness in Indonesians.

### Government policy

Indonesia had been preparing for COVID-19 since January, by assembling referral hospitals, strict supervision in entry routes (airports, harbors, roads), and performing detection in risky cities with direct access to China. Early on, non-pharmaceutical interventions (NPIs) were applied to inhibit transmissions. Individual measures include hand hygiene, usage of mask, social distancing, isolation, quarantine for contacts, and avoidance of crowded places. Environmental measures could be achieved by well ventilated rooms and routine cleaning of surfaces exposed to public. Community measures include restricting access to public places which were not essential to daily life.<sup>37</sup> Moreover, task forces were formed,<sup>38</sup> hospitals for COVID-19 were added, school and public prayer places were closed. Despite of NPIs, WHO recommended detection and isolation of infected individuals, contact tracing, treatment regimen, and travel measures regulation.<sup>26</sup>

In April, large-scale social restrictions were applied at multiple cities in Indonesia, with protocol to close schools, offices, public places as well as restriction of public transportation. Massive scale of social distancing would have the largest impact, especially when combined with other interventions.<sup>39</sup> Measures were taken as cluster cases have been reported in

confined and crowded places such as shopping malls, offices, public transportations, and hospitals. Moreover, several officials in some countries were diagnosed with COVID-19 after participating in public gatherings without masks.<sup>40</sup>

Early intervention was essential to suppress transmission before overwhelming healthcare resources.<sup>39</sup> China did a lockdown policy after the virus was identified. It appeared to be effective, showed by flattened curve, considering it has high population density. China's first wave lasted only for 20 days, while majority of countries lasted over 40 days. Countries with shorter first wave includes South Korea, which also has strict lockdown policies.<sup>41</sup> Unfortunately, restrictions in Indonesia did not seem to flatten the curve. The failure was probably due to its short duration and inability to maintain the policy persistently. Hence, transmission could rebound, potentially at the scale in which no interventions had been implemented.<sup>39</sup>

While Indonesia was incapable to implement prolonged mass social restrictions, combination of case isolation, self-quarantine, and social distancing can be alternatives.<sup>39</sup> Most of Indonesia's cluster cases occurred in office settings, raising concern whether health protocols in workplaces are effective.<sup>42</sup> As of 9<sup>th</sup> November 2020, the highest number of cluster cases was held by Indonesian Ministry offices of 1,935 cases; with Ministry of Transportation (332 cases) and Health Ministry (314 cases) in first and second, followed by private offices (1,533 cases).<sup>43</sup>

More flexible interventions to compensate economic burden can be done if high-risk groups are carefully protected.<sup>44</sup> Indonesian government had enforced vaccination for population at risk, with the hope for a fully vaccinated country. However, doubts circulating the vaccine efficiency shadowed the program. As of February 3<sup>rd</sup> 2021, only 600,000 healthcare workers out of the 1.5 million have been vaccinated.<sup>45</sup> Even though vaccination had started, citizens will require mask for months or even years to come, since asymptomatic COVID-19 spread was a huge issue early on. Moreover, vaccine needed time to develop immunity.

Government policy had gravitated toward the lenient way. The name might have changed but there were voids in implementation. Enforcement of these policies, both as an example by government officials and citizens, is paramount, considering Indonesia's new record cases every day. However, the longer the pandemic, more strain were put on healthcare, hence, more burden will arise in various sectors.

### Healthcare resources

One year to the pandemic and yet, definitive treatment has not available although vaccines showed promising results. Lack of resources complicates the capability to provide adequate testing, setting up isolation wards, and providing critical care.<sup>26</sup> Indonesia had 2,813 hospitals with various accreditation and ownership status.<sup>46</sup> From those, government have appointed 940 COVID-19 referral hospitals and even requested non-referral hospitals to provide service to COVID-19 patients.

Hospitals around the world have been overwhelmed by the pandemic beyond their available reserves. The field assessment of pandemic preparedness conducted in fifteen provinces identified gaps in the healthcare system, such as the availability of ICUs and other facilities in the event of increased cases.<sup>47</sup> In September 2020, the community health centers and ambulances were struggling to refer patients to temporary hospitals in Jakarta.<sup>48</sup> Meanwhile in January 2021, the occupancy rate of referral hospitals in Jakarta entered critical points at 95%.<sup>49</sup>

During the pandemic, temporary hospitals were the solution because they were cheaper and easier to build and run.<sup>50</sup> It had significantly improved diagnosis, admission, and treatment.<sup>51</sup> Protocols and procedures needed to be developed as soon as the hospital operates. Moreover, healthcare workers (HCWs) and staffs needed training in infection control to ensure safe, high-quality, and efficient service<sup>51</sup> because rapid redesign and redeployment of health system around the world created environment that threaten patient safety and to some extent, promote the development of harmful malpractices.<sup>52</sup> Most of the participants in our study described that hospitals need to adjust the hospital service flow, add infrastructures, carry out screening at emergency departments, apply zoning areas, and cohort COVID-19 patients. We also found types of administrative errors, delayed referral and care, prescription errors, and misdiagnoses. Delayed care has been identified more than other accidents. Administrative errors were found higher in field or temporary hospitals while delayed treatment were found at all types of hospitals.

Despite the availability of healthcare facilities, WHO has been raising concern for scarcity of HCWs worldwide, especially in developing countries. Contributing factors are poor remuneration and working conditions, completed with pandemic situation.<sup>53</sup> In Indonesia, more than 200 healthcare workers' lives have been taken by COVID-19. With a very low doctor to population ratio; only 1:250,000. Deceased doctors cannot be replaced easily since the experience will not match up. Each hospital had different strategies to manage this problem, for example, by using medical, nursing and midwifery apprentices. At temporary hospitals in Jakarta and Surabaya, HCWs were recruited by Ministry of Health or sent by organizations or Indonesian Police Force.



New infectious disease outbreaks challenged HCWs due to insufficient knowledge of the emerging threat. In addition, ensuring adequate access to skilled HCWs especially in rural and remote communities is a challenge considering disparities in both areas.<sup>53</sup> Most hospitals in Indonesia had provided adequate training or sent their HCWs to major cities to train with the government. Only one participant reported that HCWs there did not receive any training. However, that hospital developed Standard Operational Procedure (SOP) to be followed.

Skilled HCWs needed to be equipped with appropriate personal protective equipment (PPEs) as they are notably at risk for COVID-19 infection. Higher number of infection were contributed by long shifts; owing to increased number of patients and staff shortages, and excessive fatigue which weakened the immune system.<sup>54</sup> However, as infection progressed, availability of PPE becomes an issue.<sup>53</sup> Mask prices increased aggressively, some people even stole or fought for mask in some regions.<sup>55</sup> A member of a District-Government Hospital in Indonesia reckoned wearing raincoats and triple cloth masks as a PPE replacement. Furthermore, in other hospitals, HCWs would only wear PPE when required to go inside the isolation room.

When Indonesia was faced with the scarcity of PPE early in the pandemic, there were many community movements involving housewives, disabled community, and university students to produce PPE.<sup>56–58</sup> However, these good intentions raised the question of standardization, as some PPEs did not comply with WHO requirements and were provided directly to health care or HCWs. As a result, it was questionable not only the comfort, but also the efficacy in preventing transmission. Providing HCWs with proper training in patient care and hospital management complemented with adequate PPEs could reduce the burden of the pandemic in our healthcare facilities.

## Conclusion

COVID-19 pandemic is a global burden including in Indonesia. With proper strategies to overcome the pandemic, it could reduce the number of transmissions which lead to lower case fatality rate. As known, Indonesia had a high case fatality rate with total death more than 1 million. With low number of sequence available, it is difficult to trace the viral mutations that occur in Indonesia. The disparities of healthcare facilities to diagnose and treat patients between urban and rural region expands the problem. Moreover, the awareness and knowledge of the disease is inadequate in majority of Indonesian citizen. The problem is extensive. Hence, it needs a comprehensive approach from the government, citizens, even private sectors to cease the pandemic.

## Data availability

No data are associated with this article.

## Author contribution

**Miftahussurur M:** Conceptualization, Writing – Original Draft, Writing – Review & Editing; **Savitri, CAM:** Formal Analysis, Writing – Original Draft; **Waskito LA:** Formal Analysis, Writing – Original Draft; **Rezkitha YAA:** Data Curation, Writing – Original Draft; **Dhamanti I:** Data Curation, Writing – Review & Editing; **Indriani, D:** Data Curation, Writing – Original Draft; **Suyanto B:** Formal Analysis, Writing – Review & Editing; **Rianda, RV:** Data Curation, Writing – Original Draft; **Yamaoka Y:** Conceptualization, Writing – Review & Editing.

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## SURAT KETERANGAN

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Telah melaksanakan penelitian dengan judul sebagai berikut :

No.	Judul Karya Ilmiah	Tahun Pelaksanaan Penelitian
1.	Implementation of Computerized Physician Order Entry in Primary Care: A Scoping Review	2021
2.	Adverse Reactions of COVID-19 Vaccines: A Scoping Review of Observational Studies	2023
3.	Literature Review: Cause Factor Analysis and an Effort to prevent Medication Administration Error (MAE) at Hospital	2020
4.	A Literature review on the Identification of Variables for Measuring Hospital Efficiency in the Data Envelopment Analysis (DEA)	2021
5.	Telemedicine Use In Health Facility During Covid-19 Pandemic: Literature Review	2022
6.	Faktor yang Menghambat Pelaporan Insiden Keselamatan Pasien di Rumah Sakit: Literature Review	2021
7.	Comparison of Four Methods To Detect Adverse Events in Hospital	2015
8.	Infections Prevention and Control (IPC) Programs in Hospitals	2021
9.	Studi Komparatif Pengembangan Contact Tracing Applications Di Singapura dan Indonesia (Studi Kasus: TraceTogether dan PeduliLindungi)	2022
10.	Faktor Penghambat Pelayanan Kesehatan Rutin di Rumah Sakit saat Pandemi COVID-19	2021
11.	Governmental Policies in Managing COVID-19 Pandemic: Comparative Study Between Indonesia and Vietnam, Period of January – March 2020	2021

12.	Akses Pelayanan Kesehatan Ibu dan Anak di Puskesmas Selama Pandemi Covid-19	2022
13.	Comparison of Dental Care Policies Before and During The COVID-19 Pandemic: A Literature Review	2022
14.	Analysis of Implementation of Patient Identification In Hospitals to Improve Patient Safety in Indonesia	2022
15.	Literature Review: Implementation Of Patient Safety Goals In Hospitals In Indonesia	2021
16.	Literature Review: Hospital Service Quality During The COVID-19 Pandemic	2022
17.	Comparison of Hospital Emergency Room Management Regulations in Indonesia Before and During The COVID-19 Pandemic: Literature Study	2022
18.	Analisis Pelaksanaan Pelayanan Kesehatan Perorangan (Ukp) Di Puskesmas Sebelum Dan Selama Pandemi Covid-19: Literature Review	2022
19.	Perbandingan Kebijakan Pelaksanaan Imunisasi Rutin pada Anak sebelum dan selama Pandemi	2022
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25.	Lessons from Indonesia, a country with highest COVID-19 mortality rate in the world: dissecting multiple aspects	2022

Adapun penelitian tersebut layak dilakukan dan menghasilkan output yang sangat baik, meskipun belum ada **Uji Etical Clearence** karena menggunakan metode litteratur review . Demikian surat keterangan ini kami buat untuk dapat dipergunakan sebagai persyaratan pengusulan Jabatan Fungsional Lektor Kepala.

Surabaya, 13 April 2023



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