



## Keeping the scale from tipping: Bolstering the sustainability of Indonesia's data center industry development

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### ABSTRACT

The Indonesian government has demonstrated a keen interest in the digital economy. In order to further reinforce its digital economy, Indonesia has identified the data center industry as a key target for growth. The article employs a qualitative research method to elucidate potential avenues for enhancing the sustainability of Indonesia's data center industry. The article commences with an examination of Indonesia's digital economy potential and its correlation with the data center industry. In light of the projected growth of the digital industry and internet penetration, as evidenced by the 2030 estimates, the necessity for the establishment of data centers is becoming increasingly apparent. Subsequently, an analysis of the industry's financial implications is presented, with a particular focus on its considerable water and electricity consumption and associated greenhouse gas emissions. The aforementioned matter could impact Indonesia's progress in reducing its carbon footprint, not to mention other potential repercussions in numerous sectors. Domestically, Indonesia can pursue sustainable development through engaging with relevant domestic actors and promoting the wider use of renewable energy where it is deemed appropriate and feasible. Finally, with international cooperation, Indonesia can leverage its experience in ASEAN and engage with other states that are poised to develop their own data center industry.

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## Introduction

Globalization has opened the door for the emergence of countless technological advances. From advances in communication technology all the way to transportation technology, almost all levels of society have experienced the changes. The many advances the world is enjoying today have strengthened the interconnectedness that characterizes the contemporary international system. An important feature of globalization is how the internet and the technological advances have further accentuated interactions and activities in the digital realm.

One of the fruits it has yielded is the growing digitalization that is not only accentuated by globalization but also strengthened the idea of globalization itself. Governments and corporations alike have sought to carry out digital transformation to better integrate their work with the present technology. For that, there have been many moves under this umbrella like digital governance to the ever-growing ecommerce with international service. Key to the thriving digital industries the world is witnessing is data centers.

Currently, data centers hold important roles to sustain the operation of numerous digital services. Data centers can be understood as a facility that contains a lot of computers and other components that serve to sustain digital service through storing data and running the server. From the online service provided by e-commerce, digital service provided by the government, to the ever-expanding clutches of AI, all of them have their share of reliance on data centers. The ubiquity of those digital services has made the demand for data centers, among other digital infrastructure, witness immense growth. The high demand makes it a profitable opportunity for many parties to be involved in. Such a bright prospect is further supported by estimates that the

market valuation, around US\$ 328.10 billion as of 2023, could spike to around US\$ 792.29 billion by 2032 (Astute Analytica India, 2024).

Despite the rosy prospect that lies on the surface, the devil lies in the detail. In sustaining digital service and activities, data centers consume a staggering amount of electricity and water. The former is further intensified by how many data centers rely on electricity produced from fossil fuels. This makes it not surprising that industry accounts for 3.5% of global greenhouse gas emissions (Kilgore, 2024). Should it not be developed and monitored properly, it could risk giving rise to negative repercussions, specifically environmental ones that could affect the wellbeing of the people and even other security dimensions. Therefore, failure to properly cater to the environmental or social implication of the industry is tantamount to losing all the goods that developing the industry could bring. Such a thorough rumination would then be needed for states like Indonesia that has its eyes set on the industry.

Situated in the growing region of Southeast Asia, Indonesia has also caught the sensation engendered by the data center industry. Such a growth is driven by the interest to materialize the country's digital economy potential which is estimated to reach 1 trillion USD by 2030. Such an estimate does not materialize out of thin air. The country has witnessed its share of digital economy growth with the emergence of unicorn enterprises like Gojek and Tokopedia (BPPTIK, 2022). To accommodate the growth of those digital unicorns as well as other needs, both governmental and businesses alike, the data center industry is present to sustain their digital operations.

For Indonesia, the houseworks to realize the industry's potential runs the gamut from the provision of digital talents to digital infrastructures. However, as mentioned before, there lies another concern

when it comes to data centers, that being its sustainability. Such a consumption also runs against the backdrop of international regimes, like the SDGs and Paris Agreement, which Indonesia is a part of. For that, one needs to carefully consider the matter so as it would not jeopardize other sectors and the community as a whole, either directly or indirectly i.e in the long run.

In the past, there has not been plenty of research done on the topic. A look into the works of Cao et. al. (2023) can also provide some insight into the sustainability of the data center industry. The study puts forward some ways in which data center's sustainability can be improved. It is found how a data center's cooling efficiency can be improved through cognitive digital twin architecture based on its case study of a data center in Singapore. A supporting stride can also be made to the works of Manganelli et. al. (2021). In their work, the writers brought the idea of data center sustainability improvement through energy mix, conservation, and circular energy. Given how the existing landscape has mainly catered to the global or other state's data center's trend, a research gap is present over the case of Indonesia's data center landscape, specifically its sustainability matter.

Against that existing landscape, this article seeks to take a deep look into the potential and caveats of the data center industry that has taken Indonesia's attention. Moreover, the undertaking also includes an examination of the path of sustainability that Indonesia could take to sustainably develop and leverage its data center industry potential. For that, the article contains four discussion points ranging from Indonesia's digital economy potential, the caveats to developing the data center industry, the sustainable means, and international opportunities that could be explored.

## Method

In carrying out the research, the writer makes use of the qualitative research method, specifically the descriptive approach to it. Said method refers to a research method that seeks to describe existing events that entails its characteristics, quality, and relation with other matters (Sukmadinata, 2011). The undertaking that the article contains was done using the qualitative research method. In formulating its analysis, the writer makes use of both primary and secondary data procured from the internet. The former was procured from official government reports and documents whereas the latter was sourced from past studies, news coverage, and other secondary sources. With the internet serving as the main source of data, the writer also gets the opportunity to carry out triangulations through comparing one source with the other.

## Results and Discussion

### *Indulging in a reverie: Data center and Indonesia's digital economy combo*

Indonesia possesses enormous digital economy potential. Such a potential can be seen in three things, that being the amount of internet users in Indonesia, the growing ecommerce industry, and digital transformation across other sectors. For starters, Indonesia has witnessed a stronger internet penetration that results in a growing number of internet users. As of 2024, Indonesia has recorded 221.563.479 internet users which is around 79.5% of the total population (APJII, 2024). Such a percentage is a result of a consistent growth Indonesia has witnessed in the last 5 years. That huge number of internet users could serve as an enormous market for the country's growing ecommerce industry.

As mentioned earlier, the country has witnessed the emergence of numerous digital unicorns that run in the ecommerce sector. Moreover, Indonesia's attractiveness as a market has also attracted enterprises from beyond its borders. The thriving private sector in the digital realm is also followed by its government counterpart that has witnessed a move towards e-government and digital transformation. The matters further support the growing digital environment given the plethora of actors and attention it receives.

Amidst such a growing digital environment, it is not surprising for such growth to spill over to the data center industry. The growing demand and need to maintain a digital presence for consumers make data centers even more important for businesses and governments alike. Moreover, there has been a growing trend within the digital service industry that pushes the industry players to maintain a closer presence to their consumers. This would lead to a higher amount of data centers, albeit smaller in size, so they could expand their area coverage. Such a trend, combined with Indonesia's digital economy potential and the growing numbers of citizens that can access the internet further accentuate Indonesia's potential and the industry's attractiveness to be developed.

The potential that lies within Indonesia is also amplified upon changing the perspective to include the bigger landscape, the region of Southeast Asia. Southeast Asia has turned heads of numerous countries, including the global powers like the US and China, given its strategic value and role as a market considering the high population in the region. It is no surprise therefore that many enterprises from those countries seek to establish their respective digital foothold. Such a thing is present in the form of data centers that are spread across the region to cater for each state. Similar to

that of Indonesia, other states in the region have witnessed a growing interest on the government side to accentuate their digital presence.

Table 1. Amount of data centers in ASEAN member states

ASEAN member states	Amount of data centers
Indonesia	123
Singapore	63
Malaysia	73
Philippines	22
Thailand	38
Cambodia	6
Vietnam	23
Myanmar	3
Laos	1
Brunei Darussalam	1

In the past, Singapore was the key player in the region's data center industry given its advanced and adequate infrastructure that could sustain the industry. However, in 2019, the government released a moratorium that halted the amount of data centers that could be built in the state. Such a measure was taken given the high amount of electricity, water, and land that the data centers used paired with Singapore's limited amount of said resources (Kit, 2021). A few years later, specifically in 2022, the moratorium was finally lifted, allowing data centers to be built again in the country. The government also handed additional electricity, amounting to 80 MW each, for four enterprises including Microsoft and Bytedance back in 2023 (Haddon, 2024). Despite such a move, many have raised concern on whether or not it would be sufficient to adapt to the present regional landscape.

Hence, if the potential is leveraged properly, Indonesia can grow into one of the region's data center hubs that could attract international demand. To that end, some strides have been made to bring it to fruition. For example, Indonesia has begun its development of the Nongsa Digital Park in Batam. The area is set to house more data centers in the coming years with 10 data centers currently being built and an additional six waiting in the line (Saputra, 2024). The attractiveness of the industry, as seen in this one particular project, also attracts foreign investors with companies from Singapore and Hong Kong (Dewi, 2024).

Aside from that, efforts have also been taken to ensure the availability and readiness of the adequate human capital that would be needed to keep the industry up and running. The urgency to said move can be seen in Indonesia's ranking in the World Digital Competitiveness Ranking where it held the 53rd place out of 64 states. Such a move has been taken by government and private actors alike. The former has been carried out by Indonesia's Kominfo (Indonesia's Ministry of Communication and Informatics), albeit focused on supporting digital transformation (Setkab RI, 2021). As for the latter, the Nusantara Data Center Academy can be seen as the example that runs in the education field (Pasaribu, 2023).

All in all, Indonesia has some goals it could attain through developing its data center industry. However, the path to materialize its digital economy potential, including its data center industry, is not one that is devoid of any caveats. The many fruits that the data center industry could yield if its harnessed fully also comes with some matters for deliberation.

### *The staggering cost of data center*

The data center industry, being an energy-intensive industry, has its share of issues surrounding its energy consumption. A poignant feature of data centers can be seen in the enormous resources that they use to operate. In 2033, the PLN estimates that Indonesia's data center industry would require around 4 Gigawatt (CNBC Indonesia TV, 2024). The staggering energy consumption also has a growing trend amidst the growing use of AI. To deliver the result of an AI prompt, a lot of water and electricity are required to keep the machines in the data center cool (He, et al., 2023). It is estimated that around 500 milliliters of water are required to process 5 to 50 prompts (Schmee, 2023).

For Indonesia, developing its data center industry would be a move that comes with the task of providing the needed resources, notably water and electricity (Aqua Tech, 2022). Looking at the US, being the country with the most data centers, it is also facing the need to adjust its aging power grid amidst the rise of data center energy demand. Hence, it can be noted how the strides to provide the adequate amount and access to the industry would require a lot of resources.

A similar echo is also present when it comes to its water consumption. In the US, one estimate shows how data centers in the country consume around 1.7 billion liters of water each day. Moreover, research done by Li et. al. posits how by 2027 data centers that house generative AI would require around 4.2 to 6.6 billion cubic meters of water (Li et al., 2023). It is important to be cognizant of how the staggering water consumption compares to other components, for example climate change and the local communities. Many countries in the world have experienced El Niño, an atmospheric phenomenon that causes prolonged drought, including

Indonesia. Despite still being left for debate, many have argued how climate change gives rise to more frequent occurrences of El Niño (Poynting & Stallard, 2024). Against that backdrop, in 2023, numerous protests in Uruguay took place as amidst its water shortage, the government still opened the door for data center projects in the country along with its allocation of water (McGovern & Branford, 2023).

For Indonesia, such an experience is one that it can relate to give the widespread drought it experienced last year that saw more than 150.000 people experiencing clean water crisis (Prasetyo, 2023). Hence, the high-water consumption could further burden the existing water supply, already strained by the persisting drought as a result of climate change, that the local communities rely on.

Apart from the need to increase the amount of energy that can be provided to data centers, another task for Indonesia is to do so in a sustainable manner. The industry has indeed considered issues surrounding its sustainability across the globe. However, the intensity of such concern is not tantamount to the existing degree of energy and water consumption it has. The aforementioned is somewhat made dubious given some doubts on the claim of the tech companies that they have reached carbon neutrality. For example, Amazon claimed that it has achieved a gross emission cut of around 3% which does not resonate with others, for example the Amazon Employees for Climate Justice. The representative of the group mentioned how said achievement was built from creative accounting that does not represent the actual emissions on the location (O'Brien, 2024).

There have also been some projections on how much energy the industry would absorb. For example, there is the estimate that data centers in the US, by 2030, could absorb as much as 9% of its electricity. The industry also has a considerable

amount of greenhouse gas emissions that contribute to climate change. Such a huge contribution could also be further increased given the growing demand of data centers construction.

Data centers also have their share of contribution to the global greenhouse gas emission. The industry has a total greenhouse gas emission of around 2% (Thangam et al., 2024). The impact of its contribution needs to be seen along with other matters, like the growing number of data centers, its staggering electricity and water consumption, as well as its existing reliance on fossil fuel. The concern placed upon the potential emission from the industry is not born out of naught. Within Indonesia's RPJPN (National Long-Term Development Plan), the issue of greenhouse gas emission and the bigger picture of climate change is included as some of the trends or matters to be taken into account. Taking a page from it, Indonesia has taken positive strides in reducing its greenhouse gas emission as seen in the cumulative decrease of 5,65 GtCO<sub>2</sub>eq. Failure to hold the development of the industry's reign could not only jeopardize the effort to reduce the emission but it could also open the floodgate of other security repercussions. The aforementioned floodgate could run the gamut from impacts to energy to environmental security among the many security dimensions. Hence, efforts to better manage its development and emissions are ones that cannot be made light of.

Upon taking into account the other side of the data center coin, one can see how the benefit brought about by industry does come with important caveats. However, such a reality is not one that would remain unchanged. Because of that, the relevant actors in the industry and the government can strive to change it through pursuing efforts to make the industry more sustainable.

### *A greener pasture: A look into green data centers*

The sheer number of resources that the data center industry absorbs has led numerous overtures to reduce it. Either to steer clear of the rejections from the people or to ascertain that the environment would not suffer avoidable repercussions, it is important to hold the reign of the data center industry's development, especially expansion in one's country. Given the interconnected nature of its repercussions, Indonesia could not risk being blinded by the potential windfall brought about by this enticing prospect. What is meant by that is how any negative impact stemming from unsustainable practice from the industry could have far reaching implications, especially when the issue of environmental security, specifically the looming threat of climate change, and the sustainable development practice is brought to the spotlight.

For this reason, a look into efforts to make data centers green or green data centers need to be explored. To make data centers greener, some ways to reach that goal can be broken to a handful of approaches. First, a focus can be given to increasing the energy efficiency of the data centers which would reduce the amount of energy they use as well as their emissions. Secondly, pushes to use renewable energy can be given to the industry players. Fortunately, Indonesia, as elaborated later down this section, has the capacity and groundwork ready to explore and build on both paths.

In leveraging its digital economy potential, it is important for Indonesia to not lose track of the sustainability consideration. An important opportunity for its sustainable development lies in the industry's use of clean and renewable energy. For this, Indonesia could leverage its renewable energy potential (Purwanti, 2024). Indonesia

has a plethora of said resources, from solar energy to geothermal which it has also sought to include in its overall electricity supply. While it is true that not every area shares the same renewable energy potential, they nonetheless possess their respective potential, i.e how some regions in Java have the potential for solar energy whereas others may have the potential on geothermal and such (Kurniawan et al., 2023). Moreover, referring to Indonesia's Ministry of Energy and Mineral Resources (KESDM) first semester report, the government has put its focus to support the development and investment on renewable energy. For the latter, in the period of 2020 and 2024, Indonesia's renewable energy investment has reached an investment realization of around 6.6 million USD (Kementerian ESDM, 2024).

The examples for this path can be seen in other countries, notably the US which houses the highest number of data centers globally. There, the growing numbers of data centers has paved the way to more opportunities for renewable energy developers, notably solar and wind energy (Ford, 2024). The importance to this prospect is further accentuated as the Biden administration recently launched the AI data center task force (Bloomberg News, 2024). Renewable energy is deemed as a viable means to face the growing data centers demand as they are scalable and competitive when it comes to its cost.

Relevant policies could also be implemented to encourage the companies to use green energy. Such a feat could be done through providing tax refunds and other green incentives to companies that fit the bill (IDPRO, 2024). For this particular means, a look into other government's policies can be taken. A relevant example that can be investigated is the Inflation Reduction

Act (IRA) in the US that provides a range of benefits like tax credit and tax holiday to those who have taken the strides to use green and renewable energy (US EPA, 2024). Indonesia has taken some strides to address the sustainability issue. One of the ways that has been taken to ensure sustainability is through certification programs. Some data centers in Indonesia have earned renewable energy certificates as a token of their commitment to utilize renewable energy for their operation (Allain, 2023). Such a move could then be further bolstered by enriching the contents within the certification program or through connecting it with other government programs that could put more benefit on the table. Such a benefit could then serve as a measure to attract and keep track of the relevant actors' commitment to sustainable practice.

The government could work together with relevant parties in the industry, ranging from key industry players to the relevant association, for example Indonesia Data Center Providers (IDPRO). In doing so, important insight into the industry's present state as well as potential hindrances and opportunities to the path of sustainability could be gathered. An example can be made out of IDPRO and the Indonesian Energy Conservation and Efficiency Society (MASKEEI). The aforementioned actors spearheaded the formulation of the White Paper on Indonesia Green Data Center (IDPRO & MASKEEI, 2022).

The document encompasses numerous matters that can be worked on by the government and industry actors alike, from the meaning of a green data center to its management and emission calculation. Despite the limited focus on increasing energy efficiency, the initiative can nonetheless serve as a base through which future efforts can be made. For example, the creation of a guideline on data center energy

efficiency and sustainability that the Asian Development Bank (2017) has stipulated in its report years back (ADB, 2017).

Through the knowledge provided by said interaction, efforts to explore other ways to ensure the sustainability of its data center industry could be carried out. This could be done by involving government and non-governmental actors in carrying out the cooperation. Additionally, efforts taken in the domestic realm can also be supported by those taken by involving international partners, something Indonesia could develop given its tapestry of engagement with both state and non-state actors in the last decades.

### ***Beyond the borders: The international stride***

Aside from its domestic endeavors, Indonesia also has the option to explore opportunities beyond its border. For this, Indonesia can explore opportunities that lie within its regional home of Southeast Asia and beyond where it can engage with both state and nonstate actors. For the former, Indonesia can collaborate and take pages from other states' initiatives on sustainable or green data centers. Take the underwater data center prospect for example. China recently began its own underwater data center projects around Hanan island (Moises, 2024). Being an archipelagic state, Indonesia could also explore its potential to develop this particular type of data centers.

Aside from learning of other states' practice or initiative, Indonesia can also engage multilaterally to develop a joint approach to the industry's development as well as the means to govern it, specifically its sustainability. A similar stride could also be taken in relation to ASEAN, the regional bloc of Southeast Asia. The path of ASEAN has its luster in how the trend of data center growth is not one that Indonesia experiences



alone, rather it is somewhat shared across the region. For starters, the data center sensation is not only felt by Indonesia, Singapore, or Malaysia, but also other ASEAN member states, for example Vietnam (Medina, 2024). In general, most, if not all, ASEAN member states can be tagged along when it comes to deliberation involving the digital economy, a sector that the data center industry is also linked to.

For the issue of digital economy, ASEAN member states have more or less settled on the same page when it comes to the potential that lies in the region's digital economy. Such a voice can be heard from the ASEAN Leaders' Statement on the Development of the ASEAN Digital Economy Framework Agreement (DEFA) which was released in 2023 under Indonesia chairmanship. The document contains the regional bloc's government interest in leveraging the region's potential as well as strengthening it through an additional framework like the aforementioned DEFA.

Then, there is also the interconnected nature of issues pertaining to sustainable development and its implication to the region as a whole. As previously mentioned, for the energy intensive industry to grow with no restraint, there lies repercussions which could affect the region, especially its environment. Therefore, an opportunity lies to spearhead a multilateral framework or initiative to govern the industry's growth in the region. For this, one can take a gander at the works of other regional blocs, for example the European Union (EU). The EU has developed its own instrument when it comes to its data center industry, e.g. the Commission Delegated Regulation 2024/1364 and the Energy Efficiency Directive (EED). The former is focused on laying out the information and requirements to the data center sustainability rating within the European Union (European Commission,

2024). On the other hand, the EED serves as the directive for energy efficiency targets among its member states. The latter has expanded to data centers in 2023 as it requires data centers to monitor and report their energy performance (European Commission, n.d.).

Taken together, Indonesia could take the opportunity to be one of the states on the region's spearpoint when it comes to its renewable energy development. Such is the case given said matter's potential for the region's data center industry and overall journey to attain the SDGs. In undertaking such a feat, Indonesia could opt to either start with a blank page by working with others to make a whole new initiative within ASEAN or it could adjust or add on existing ASEAN instruments. For the latter, ASEAN has a relevant initiative, like the ASEAN Plan of Action for Energy Cooperation (APAEC) which could be opted as a starting ground on the matter.

Apart from state actors, non-state actors can also be engaged to make data centers more sustainable, especially in terms of their energy and water consumption. One such initiative was carried out by Microsoft in its underwater data center project known as Project Natick. This particular overture involving Microsoft can be one looked into more thoroughly given Microsoft's interest to establish its foothold in Indonesia. For starters, Microsoft already has its own initiative to its approach towards Indonesia known as Empower Indonesia's Digital Economy (Berdayakan Ekonomi Digital Indonesia). Said initiative was announced in 2021, the same year where Microsoft also set out on its plan to establish its first data center in Indonesia (Microsoft Stories Asia, 2021). Moreover, in 2024, Microsoft announced that it will invest around US\$1.7 billion in Indonesia, specifically in new cloud and AI infrastructure as well as training initiatives (Microsoft Stories Asia, 2024).

Such a cooperative overture is also paired with Indonesia's growing attention to green and renewable energy. Indonesia could keep on its trajectory of growth in the sector to assure investors of its commitment to sustainability in the industry. Such a commitment resonates with the present trend in the energy intensive industry as they could share their interest on that matter with Indonesia. Given Indonesia's vast renewable energy potential, this could be another point of leverage. Especially in other regions, some industry players have sought to get a better grip on clean energy by going as far as pursuing the use of nuclear energy for their data centers. Recently, both Google and Amazon have announced their plan to invest or purchase nuclear energy from small modular reactors enterprises, like the Kairos Power (John & McDermott, 2024).

All in all, Indonesia has many means to pursue the improvement of its data center sustainability, either domestically or internationally. For the latter, Indonesia could leverage its diplomatic prowess, especially in the regional context of Southeast Asia, to procure the support and resources that it can use to maintain the sustainability of its data center industry development.

## Conclusion

With the growing luster of the digital economy and the backdrop of digitalization, the data center industry has grown more and more attractive worldwide. Indonesia has the potential to explore this growing industry given its interest to pursue its digital economy potential as well as its already existing data center landscape. Setting aside challenges involving Indonesia's digital infrastructure and its human capital, there also lies another caveat pertaining to the industry's sustainability. The sustainability

issue surrounding data centers is not one that could be swept under the rug. Such is the case given this energy intensive industry's consumption when it comes to electricity and water as well as its greenhouse gas emissions. To maintain the sustainability of this growing industry, Indonesia could take both domestic and international strides. For its domestic strides, Indonesia could strive to either increase the data center's energy efficiency or push for more renewable energy usage among the data center providers.

For either one of said paths, Indonesia happens to have the groundwork already laid out. When it comes to international moves, Indonesia could leverage ASEAN and Southeast Asia's digital economy potential to bolster cooperation on sustainable data centers with other member states. Beyond the banner of ASEAN, Indonesia could also seek to engage and learn from other states, like China, given its focus on developing its own data center industry. The same effort can also be executed by engaging with non-state actors like Microsoft and other tech companies that have turned their eyes on Indonesia. Amidst the growing fixation on the data center industry in the international system, shared by state and non-state actors alike, Indonesia could seek to align its interest to develop its data center industry potential and the need to carry it out in a sustainable manner. Through those approaches and considerations, Indonesia could take the strides to develop and maintain the sustainability of its data center industry.

Upcoming endeavors could further enrich the existing knowledge landscape through exploring other relevant topics. For instance, a look into the pentahelix cooperation opportunity in Indonesia or even ASEAN could be explored. The same effort could also be made to show how a regional approach to govern the data center

industry could be beneficial despite the industry's varying degree of growth among ASEAN member states.

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## Declaration of Ownership

This article is my original work.

## Conflict of Interest

There is no conflict of interest to declare in this article.

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