



## Research on Biopharmaceutical Innovation in Africa Based on Patent Information

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### Abstract

**Objective** To explore the current state of biopharmaceutical innovation in Africa by analyzing patent data related to biopharmaceutical products in African countries. **Methods** Based on patent data, simple descriptive statistical methods were used to analyze the trend of patent applications, the geographical distribution of patents, and the distribution of applicants in the pharmaceutical field in Africa. Besides, Excel software was used to draw charts to visualize statistical information. **Results and Conclusion** According to the result, a large number of patents has been granted in these countries and the number is steadily rising each year. From the figure below, we can see that the largest number of patents was granted to Morocco in 2014 with a total number of 613 patents followed by Tunisia with 315 patents, the African Intellectual Property Organization (OAPI) with 124 patents, South Africa with 106 and Mozambique with 1 patent based on data availability (IncoPat Global Patent Search Database). It was observed that, as patents were granted, the number of applications filed on this continent increased. The largest number of patents has been recorded by Morocco, Tunisia and South Africa. Patent applications in Morocco increased fast with an average annual growth of 7.3%. The increase in patent applications is due to improved research infrastructure and enhanced research activities, which shows the importance of biopharmaceutical innovation in the continent.

**Keywords:** biopharmaceutical innovation; patent; statistical analysis; challenges and suggestions

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The continent of Africa has one of the biggest populations in the world with over 1.2 billion people and is projected by the UN to increase to over 2 billion by 2050 <sup>[1]</sup>. The majority of these people reside in countries with high infant mortality rates, poor maternal health outcomes, and low access to healthcare <sup>[2]</sup>. In addition to the direct effects of these healthcare challenges, they also pose a significant burden to public health systems due to additional time spent

treating sick patients and high rates of re-admissions. A key strategy for improving public healthcare outcomes and increasing access to health care is to provide more effective and affordable medicines. However, at present, the majority of African countries struggle to achieve this goal due to great barriers to pharmaceutical development <sup>[3]</sup>. These challenges include limited funding, underdeveloped research infrastructure, and poor IP protection <sup>[4]</sup>. To address this problem, most African governments are seeking innovative strategies to encourage biopharmaceutical development and increase access to treatment that will

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support better health outcomes for their citizens <sup>[5]</sup>. This includes efforts to develop local capacity in the drug discovery and development process by building research partnerships between academic institutions and industry as well as promoting the development of generic drugs that can be manufactured locally <sup>[6]</sup>. Although these approaches are promising, they alone will not eliminate the barriers to pharmaceutical development that are faced by most African countries. To overcome these challenges, African governments should greatly expand funding for R&D and invest in robust intellectual property systems to protect innovative medicines from piracy and illicit trade <sup>[7]</sup>. Despite these challenges, there are examples of successful pharmaceutical development in the region that have the potential to transform the health of their populations <sup>[8]</sup>. For example, South Africa's Council for Scientific and Industrial Research (CSIR) has developed several novel anti-retroviral drugs that have saved the lives of thousands of HIV patients <sup>[9]</sup>. Similarly, the Malawian government has sponsored clinical trials of cost-effective malarial treatments developed by a local pharmaceutical company that has been effective in reducing mortality rates and improving health in children living in rural areas <sup>[10]</sup>. These examples show that with the right incentives and support, it is possible to develop innovative medicines to improve public health in resource-limited settings such as Africa. The challenges encountered by the pharmaceutical industry in developing new drugs for the treatment of HIV and other diseases that are prevalent in developing countries cannot be solved overnight <sup>[11]</sup>. It will take sustained commitment and resources from all stakeholders to overcome these challenges and ensure that the people of Africa have access to affordable and effective pharmaceuticals <sup>[12, 13]</sup>. In conclusion, fostering collaboration between governments, academic institutions, and the pharmaceutical industry is crucial for developing innovative medicines that can meet Africa's unique healthcare needs and promote long-term health improvements across the continent.

## 1 Research methods and data sources

### 1.1 Research method design

The methodology is based on the following stages: (1) Selection of the search parameters; (2) Identification of relevant literature; (3) Review of collected materials; (4) Coding and analysis of collected data; (5) Presentation of results.

Based on patent data, simple descriptive statistical methods were used to analyze the trend of patent applications, the geographical distribution of patents, and the distribution of applicants in the pharmaceutical field in Africa. Excel software was used to draw the charts to realize the visualization of statistical information.

A patent search was conducted using IncoPat Global Patent Search Database to determine the need for biopharmaceutical innovation in Africa. This research uses literature sources and interviews with experts. The sources mainly include reports and publications related to biotechnology innovation. Other sources are academic papers related to the topic. The information obtained from the patent search and statistical analysis indicates that there are a number of gaps in biopharmaceutical research that should be addressed by African countries. Moreover, developing alternative drugs to the ones that are currently available can greatly benefit people in Africa by reducing the prevalence of these diseases. Based on the findings of the study, a number of recommendations are made on how to address the existing gap in research and development of innovative drugs as well as on how to create an effective framework for further research and development in the area of biopharmaceutical sciences.

### 1.2 Data source and processing

Data collection is carried out through advanced search in IncoPat Global Patent Search Database. An analysis of African biopharmaceutical patents filed from 2004 to 2023 was carried out. A total number of



1 211 patents was collected, and the tool used makes it possible to track the patent trends in the industry and forecast future trends in the continent. The database provides statistics on the number of patent applications and granted patents by year, as well as a breakdown of patent filings by drug classes and the number of active pharmaceutical ingredients within those classes.

## 2 Research results

### 2.1 Trend analysis of biopharmaceutical patent applications in Africa

Fig. 1 demonstrates the evolution of the number of patents filed over time. From 2004 to 2010, there was a slight increase in the number of patents filed. However, from 2011 to 2012, there was a decline due to policies and low investments. In 2013, there was an increase in the number of patents filed. The increase in the number of patents filed over time is due to several factors including an increase in the number of applicants as well as an increase in the quality of applications received. A possible reason for the decrease

in the number of patents filed in 2015 was a change in government policies that resulted in a significant drop in funding to science and technology institutions which led to a decrease in the number of patents filed and funding given to researchers. In previous years, the government funding was largely directed toward agricultural research which accounted for a large percentage of the country's GDP. However, due to the decline in the amount of funding being allocated to biopharmaceutical research, the government was forced to redirect funding and resources to other areas of the economy such as the information and communication technology sector to remain competitive globally. This resulted in a decline in the number of patents filed during that period. The number of applications for African patents continues to decrease year by year. The declining numbers reflect the urgent need for increased investment and support towards biopharmaceutical research in Africa. Investment in biopharmaceutical research will not only enhance the development of innovative drugs and therapies but also drive economic growth, create jobs, and ultimately improve the overall health and well-being of African populations.

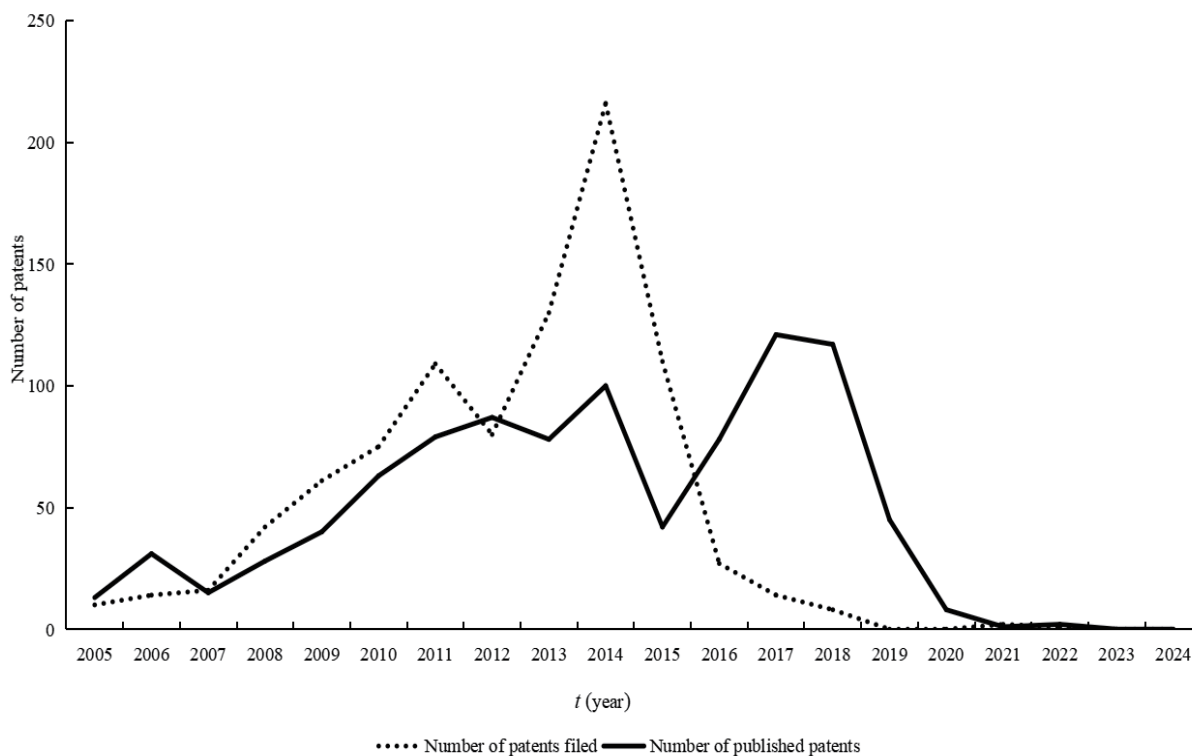


Fig. 1 Pharmaceutical-related patent applications in Africa - publication trend chart



### 2.2 Analysis of the leading regions of biopharmaceutical innovation in Africa

Based on our research, Morocco, Tunisia, South Africa are the leading regions of biopharmaceutical innovation in Africa. This is due to the presence of established pharmaceutical companies, increasing investment in research and development, favorable government policies and initiatives, as well as a growing number of clinical trials and collaborations with international organizations. As a result, these regions are likely to experience continued growth and expansion in the biopharmaceutical industry in the coming years. This analysis provides valuable

insights for stakeholders in the biopharmaceutical industry who are interested in exploring opportunities and partnerships in Africa. Moreover, it highlights the potential of these regions to serve as key players in driving healthcare advancements and improving patient outcomes across the continent.

Table 1 shows the ranking of applicants for pharmaceutical-related patents in Africa. The company with the largest number of applicants is Eli Lilly&Co. (109), followed by Novarrtis AG (90), Actelion Pharmaceuticals Ltd. (38), Glaxo Group Ltd. (37), Sanofi SA (29), F. Hoffmann-La Roche (28), Boehringer Ingelheim (23), Bristol Myers Squibb (21), Smithkline Beecham (19), and Amgen (18), respectively.

**Table 1 Ranking of applicants for pharmaceutical-related patents in Africa**

Applicant	Number of patents
Eli Lilly&Co	109
Novarrtis AG	90
Actelion Pharmaceuticals Ltd.	38
Glaxo Group Ltd.	37
Sanofi SA	29
Hoffmann-La Roche	28
Boehringer Ingelheim	23
Bristol Myers Squibb	21
Smithkline Beecham	19
Amgen	18

This ranking can serve as a useful reference for stakeholders in the pharmaceutical industry to gain insights into patent activity in Africa. It is worth noting that the ranking may change over time as new patent applications are filed and approved. Therefore, stakeholders need to keep up-to-date with the latest patent activity and trends in Africa. Additionally, this information can aid policymakers to identify potential areas of growth for the pharmaceutical industry. Besides, it can develop strategies to support innovation and investment in the sector. Furthermore, this ranking highlights the need for African countries to develop and implement effective intellectual property policies to encourage innovation in the pharmaceutical

industry and protect the right of patent holders. It is also important to note that this ranking only includes pharmaceutical-related patents and does not take into account the innovation or intellectual property activity in other industries or sectors. In conclusion, the ranking presented in Table 1 can serve as a valuable resource for stakeholders interested in patent activity within the African pharmaceutical industry.

### 2.3 Analysis of biopharmaceutical related patents innovation in Africa

The analysis includes patents related to pharmaceutical technologies in Morocco,



Tunisia, OAPI, South Africa and ARIPO. The detailed information on the global distribution of pharmaceutical-related patented technologies in Africa is shown in Table 2. The meaning of IPC classification codes in African pharmaceutical-related patents is detailed in Table 3. The number of patents filed for medicinal, dental or cosmetic preparations (512, 246, 100, 75, 43), specific therapeutic activity of a compound or pharmaceutical preparation (348, 177, 72, 42, 42), heterocyclic compound (267, 143, 62, 38, 27), peptide (85, 68, 9, 14, 0), acyclic or carbocyclic compounds (26, 13, 22, 18, 8), microorganisms or enzymes, compositions, propagation, preservation or maintenance of microorganisms, variation or genetic engineering, culture media (21, 9, 3, 8, 0), preservation of human beings, culture media (21, 9, 3, 8, 0), Preservation of human beings, animals or plants or parts thereof, biocides, for example, as disinfectants, as pesticides or as herbicides, pest repellants or attractants, plant growth regulators (20, 7, 9, 2, 1), sugars, and their derivatives, nucleosides, nucleotides, nucleic acids (11, 5, 8, 5, 9), acyclic, carbocyclic or heterocyclic compounds containing elements other than carbon, hydrogen, halogens, oxygen, nitrogen, sulfur, selenium

or tellurium (7, 4, 6, 4, 4), fermentative or enzymatic synthesis of target compounds or compositions or separation of optical isomers from racemic mixtures (9, 2, 3, 6, 3). This data can help pharmaceutical companies to make informed decisions on which areas to focus their research and development in Africa. By analyzing the patent technologies related to pharmaceuticals in Africa, companies can identify areas with high potential for innovation and growth.

Patent technology applications related to pharmaceuticals in Africa are on the rise as companies search for new and innovative ways to address the growing needs in the continent. According to statistics from the IncoPat Global Patent Search Database, applications for patents models from Africa have grown exponentially over the years, with the number of patents issued by African national offices increasing by 58% from 2004 to 2023. Many of these patents relate to the development of pharmaceutical products and processes that are designed to address specific medical challenges facing communities in the continent, including the use of traditional medicines and the emergence of new pathogens or drug-resistant strains of existing diseases.

**Table 2 Global distribution of pharmaceutical-related patented technologies in Africa**

IPC	Morocco	Tunisia	African Intellectual Property Organization (OAPI)	South Africa	African Regional Intellectual Property Organization (ARIPO)
A61K	512	246	100	75	43
A61P	348	177	72	42	42
C07D	267	143	62	38	27
C07K	85	68	9	14	0
C07C	26	13	22	18	8
C12N	21	9	3	8	0
A01N	20	7	9	2	1
C07H	11	5	8	5	9
C07F	7	4	6	4	4
C12P	9	2	3	6	3



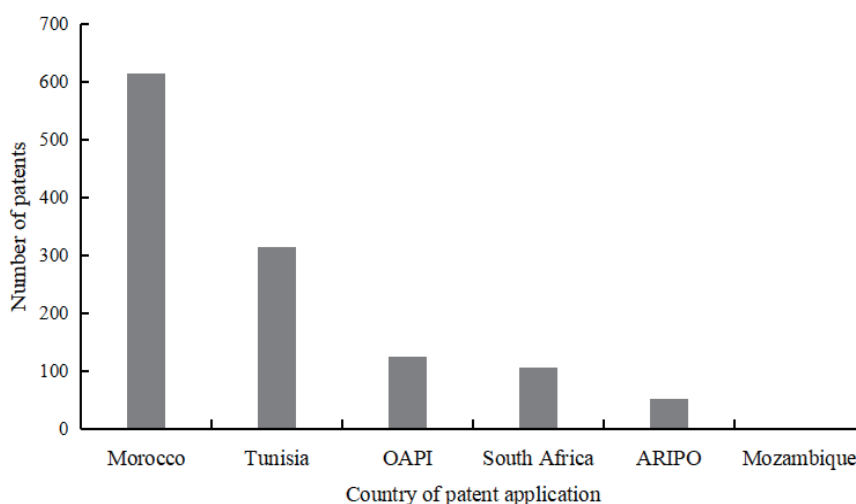
**Table 3 Meaning of IPC classification codes in African pharmaceutical-related patents**

IPC	Meaning
A61K	Medicinal, dental or cosmetic preparations
A61P	Specific therapeutic activity of a compound or pharmaceutical preparation
C07D	Heterocyclic compound
C07K	Peptide
C07C	Acyclic or carbocyclic compounds
C12N	Microorganisms or enzymes; Compositions thereof; Propagation, preservation or maintenance of microorganisms; Variation or genetic engineering; Culture media
A01N	Preservation of human beings, animals or plants or parts thereof; Biocides, for example, as disinfectants, as pesticides or as herbicides; Pest repellants or attractants; Plant growth regulators
C07H	Sugars and their derivatives; Nucleosides; Nucleotides; Nucleic acids
C07F	Acyclic, carbocyclic or heterocyclic compounds containing elements other than carbon, hydrogen, halogens, oxygen, nitrogen, sulfur, selenium or tellurium
C12P	Fermentative or enzymatic synthesis of target compounds or compositions or separation of optical isomers from racemic mixtures

**2.4 Histogram of geographical distribution of pharmaceutical-related patents in Africa**

The histogram below displays the geographical distribution of pharmaceutical-related patents in Africa. It appears that the majority of pharmaceutical-related patents in Africa are concentrated in Northern

and Southern regions, with relatively few patents registered in Western and Central Africa. This suggests that there is an imbalance in the development and innovation of pharmaceutical products within the continent, which could have implications for access to healthcare and availability of treatments in certain regions.



**Fig. 2 Histogram of geographical distribution of pharmaceutical-related patents in Africa**

Fig. 2 shows the histogram geographical distribution of pharmaceutical-related patents in Africa, it is evident that a significant portion of patents was filed in Morocco and Tunisia due to data

available from the IncoPat Global Patent Search Database. Of the African countries listed in the analysis, Morocco had the largest number of patent applications, followed closely by Tunisia. This trend



highlights the growing importance of pharmaceutical innovation and intellectual property protection in these two countries, potentially setting a strong foundation for future advancements in the African pharmaceutical industry. From the figure above, Morocco recorded 613 patent applications, while Tunisia had 315 patent applications in the pharmaceutical sector. This data suggests a promising outlook for pharmaceutical development and investment opportunities in North Africa, which could ultimately benefit the entire continent's healthcare landscape. In contrast, other African countries have much lower patent application numbers, indicating a need for increased support and resources to bolster their pharmaceutical sectors. OAPI had 124 patent applications, demonstrating the potential for growth in member countries and the importance of regional collaboration to strengthen intellectual property rights across Africa. It is essential for governments, international organizations, and private sector partners to recognize this disparity and work collaboratively to foster innovation, provide necessary resources, and develop robust intellectual property frameworks throughout the African continent. South Africa, another notable player in the region, recorded 106 patent applications, emphasizing its role as an emerging leader in the pharmaceutical field and showcasing the potential for growth and collaboration among African nations to enhance their pharmaceutical capabilities and improve overall healthcare systems. ARIPO recorded 52 patent applications, further underscoring the need for increased cooperation and knowledge-sharing among its member countries to drive innovation and build a more robust pharmaceutical industry across the region. Mozambique, with only 1 patent application, highlights the need for targeted efforts and investments to encourage pharmaceutical innovation in countries lagging behind their peers. In conclusion, these varying patent application numbers across Africa emphasize the importance of fostering collaboration and sharing resources to promote a more robust pharmaceutical industry, which could ultimately lead to better healthcare access and improved outcomes for the entire continent.

### **3 Challenges for biopharmaceutical innovation in Africa**

#### ***3.1 Cost of setting up facilities***

One major challenge facing new biopharmaceutical development in Africa is the cost of setting up such facilities. Commercially successful drug development is expensive and often requires a significant investment in research infrastructure. Setting up a new facility in this area can be extremely expensive, especially for African countries with limited financial resources. As a result, many African nations lack the capabilities to develop their own pharmaceutical industry. In most cases, foreign pharmaceutical companies are required to conduct all research and development operations locally. This makes it difficult for the local African population to gain access to new drugs and treatments.

#### ***3.2 Lack of highly qualified personnel in the region***

Unfortunately, there is limited capacity for training high-quality talents in many African countries. This makes it very difficult for African countries to develop their own in-house capacity to conduct biomedical research. This problem is even more severe in countries that have experienced long periods of conflict or civil unrest, such as South Sudan and Somalia. As a result of this lack of well-trained personnel, many countries rely on Western pharmaceutical companies to conduct all R&D operations within their borders. This limits the local availability of new treatments and contributes to the relatively high prices of many medications.

#### ***3.3 Limited number of clinical trials conducted in Africa***

If a new drug wants to be approved for use in the United States, it must go through a series of clinical trials before it is approved for sale. These trials take place in a laboratory setting and can take several years to complete. In recent years, only a few clinical trials have been conducted in Africa. Many major pharmaceutical



companies are reluctant to conduct clinical research in Africa due to the high costs and low demand for their products there. In addition, it can be difficult to recruit patients for clinical trials in most African countries due to the high level of poverty in the region. This makes it more difficult for companies to determine the safety and effectiveness of new treatments before they can make them available to the general public.

### ***3.4 Lack of local expertise***

In many African countries, the industry is still in its infancy and there are currently no local industry players. The lack of local expertise poses a major problem for Africa-based biopharmaceutical companies to design the innovation, research and development. Biopharmaceutical companies are currently dependent on external funding for research and development, which can be very difficult to obtain in most African countries. The market and demand for drugs and diagnostics in Africa are very small, which makes it hard for African biopharmaceutical companies to make profit. Therefore, it is difficult for African biopharmaceutical companies to attract large companies to develop their product and market it globally.

## **4 Suggestions for biopharmaceutical innovation in Africa**

The biopharmaceutical industry in Africa has immense potential for growth and innovation, as the continent grapples with a variety of healthcare challenges. Here are some detailed suggestions for innovation in the biopharmaceutical industry in Africa.

### ***4.1 Establishment of national research***

Government needs to establish a national research and development strategy to develop indigenous products and medical devices and capitalize on their competitive advantages. They should invest in research and development to enable them to develop new medicines to meet the healthcare needs of patients in Africa. However, it is important to provide them

with the resources needed to carry out their research efficiently so that they can produce high-quality research that is relevant to the needs of the market.

### ***4.2 Collaboration with the stakeholders***

Stakeholders in the African pharmaceutical industry should collaborate more with each other to ensure that they can learn from each other's experience. This could help improve the efficiency of their operations and help them to overcome some of the challenges they face. In addition, it could also help them to develop their workforce by providing them with the necessary skills to enable them to meet future demands.

### ***4.3 Improvement of infrastructure***

Government should take steps to improve their infrastructure so that they can overcome the challenges that their facilities present. For example, they need to invest in new production facilities and laboratory equipment so that they can develop new medicines quickly and efficiently. In addition, they also need to improve the logistics and distribution systems that they use to move their products to consumers across the country. This will enable them to ensure that more of their products reach consumers on time and at a lower cost.

### ***4.4 Improvement of the quality of workforce***

The quality of their workforce should be improved to ensure that they have the skills necessary to develop innovative products to meet the needs of the market. However, this is particularly important in countries where the supply of healthcare professionals may be limited. By providing them with the necessary training, they can develop the skills that they need to serve their patients effectively. In particular, there should be a greater focus on building a skilled workforce and creating a supportive environment for the pharmaceutical sector in Africa. Other potential opportunities include improving access to medicines and supporting research and development efforts.



All of these efforts could potentially lead to the development of innovative new therapies for a range of conditions.

#### 4.5 Creation of a vibrant innovation ecosystem

A possible solution for African biopharmaceutical companies is to create a vibrant innovation environment for the continent, especially for the underdeveloped markets in Africa. This can be done through collaborations with the local authorities, private industry and research institutes, as well as international funding from the government, private companies and research bodies. The current patenting and regulatory environment, lack of public-private partnerships and policy framework for regulating the industry and access to healthcare are still barriers to be tackled.

#### 4.6 Promotion of foreign investments

There are three main steps that could be taken to address these issues. The first step is to promote foreign investment and encourage the growth and development of the pharmaceutical sector in Africa. This would provide a much-needed boost to the local economy and create more jobs in the area. It would also provide an opportunity to access a broader range of skills and perspectives that could benefit the company as a whole. The second step is to improve access to healthcare and infrastructure throughout Africa. This would make it easier for people to receive treatment and would also provide more affordable healthcare options for low-income families. Finally, the focus should be on capacity building and training to ensure that there is a qualified workforce able to provide high-quality healthcare.

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