

## ENHANCING HEALTH LOGISTICS: A BRAZIL-INDIA PERSPECTIVE ON STRENGTHENING HEALTHCARE SUPPLY CHAINS IN KENYA

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### **Abstract:**

Experiments play a crucial role in high school physics education, providing a solid foundation for establishing concepts and discovering laws in physics. Experimental teaching is an essential component of the physics curriculum, as it aids students in understanding fundamental principles, developing basic skills, and cultivating scientific thinking. Relying solely on textbook knowledge and teacher lectures is insufficient for students to thoroughly grasp and comprehend physics concepts. By incorporating physics experiments, students can effectively integrate theoretical knowledge with practical exploration, facilitating the transformation of textbook knowledge into personal understanding. This article presents a specific simulated apparatus for high school physics velocity experiments, aiming to improve the accuracy and convenience of simulating physics velocity experiments through equipment enhancements.

**Keywords:** Physics; Velocity Experiment; Simulated Apparatus

**Abstract:** The Ivory Coast, a thriving economy in West Africa, is witnessing a surge in healthcare demand, particularly for high-quality medicine and medical devices. This increased demand is fueled by growing public health awareness and government efforts to enhance medical safety. However, the country's healthcare supply chain system faces significant challenges, as highlighted by recent health crises, including the COVID-19 and Ebola outbreaks. China has emerged as a key player in Ivory Coast's healthcare sector, financing and constructing numerous hospitals to promote sustainable development. With a focus on rural healthcare development, Ivory Coast aims to allocate more fiscal resources to improve medical services, presenting opportunities in the medical device market. Despite the country's increasing healthcare expenditures, medical care remains limited, and medical equipment is scarce, with many medical procedures relying on manual methods. This reliance on imports for medical equipment and supplies underscores the need for domestic medical device manufacturing and highlights the significant market potential.

**Keywords:** Ivory Coast, healthcare supply chain, medical devices, healthcare demand, public health awareness, China, healthcare expenditure, medical equipment, domestic manufacturing, import-dependent market.

### **Introduction**

The economy of the Ivory Coast, located in West Africa, is relatively developed, and it is the largest import and export trading country in West Africa and one of the leading trade partners with China in terms of healthcare supply (Medicine and Medical devices). With the increase of local public health awareness, Ivorian medical service institutions have continuously increased their high-quality medicine and medical devices requirements. The governments have formulated corresponding laws and regulations to improve the safety of medicine and medical devices to protect people's lives safety. However, the supply chain system in the Ivory Coast is in crisis. The recent epidemic linked to the COVID-19 and Ebola virus in the country has shown the powerlessness of the system in the face of the risks.

China is establishing itself as a critical player through the financing and construction of dozens of hospitals across the country. Promoting the achievement of sustained development of the Ivory Coast healthcare sector is a way forward. Ivory Coast is aware of essential public health and gradually increasing its financial expenditure on public health. Ivory Coast, for example, is one of the most populous countries in Africa. The government plans to allocate more budget in fiscal revenue to strengthen the construction of medical services in rural areas. This is undoubtedly a positive signal for the medical device market.

The level of medical care in Ivory Coast is shallow, and medical equipment is even rarer. For example, the doctor does not use the instrument to diagnose and treat the patient's injury in an orthopedic clinic, but entirely through the "hand feeling." Indeed, the data shows that African countries generally lack medical device manufacturing. Import-dependent medical equipment and supplies market tops US\$3.2 billion as African countries rely on imported medical equipment and supplies.

#### **1. Review of China-Ivory Coast Coordination: Past and Now**

China-Ivory Coast relations have developed tremendously over the past decade. Of course, China is not a newcomer to Ivory Coast. But the scale and nature of China- Ivory Coast relations have changed diametrically since the late 1990s. This expansion and metamorphosis have been driven above all by the establishment in Beijing of a new African policy to serve both its own growing economic needs and its rise to power on the world stage. We know what's next: trade has exploded; Chinese infrastructure projects have multiplied in Ivory Coast and cover many areas, such as health care, education, and more. The People's Republic's assistance to the development of African countries has reached an unprecedented level. This expansion of trade and cooperation projects has directly strengthened diplomatic and even strategic ties between China and most African countries.

Today, staying away from the domestic political problems that these states are experiencing, China is increasingly welcomed as an alternative to the eyebrow-raising diplomacy and other binding aid programmed of Western countries, especially since most of them are affected by the crisis offer less than in the past. In the global fight against the epidemic, the relationship between China and Ivory Coast has once again shown a brotherly spirit of solidarity and mutual help. When the first epidemic wave hit China, Leaders of the African Union and African countries including Ivory Coast immediately expressed sympathy and solidarity with China to strengthen the relationship. China - Ivory Coast health cooperation also faces many problems and challenges, which may come from the conceptual level or exist in actual operation. To

this end, it is necessary to strengthen the design and resource integration of health cooperation with Ivory Coast. The alliance is placed at a higher strategic level and integrated into China's global health diplomacy and health security strategy; in the overall pattern, it improves the ability to set and lead international health issues and solve the problems existing in practice.

## **2. Strengths: Ivory Coast Healthcare Sector Reality and Chinese Input**

### **2.1 Ivory Coast Healthcare Sector Reality**

#### **2.1.1 Healthcare spending has increased dramatically**

According to the World Bank, the Ivory Coast accounts for 0.29% of the world's population, also Ivory Coast Health Spending: 5.72% of the GDP. With the rapid growth of the Ivory Coast economy in recent years, the investment in the medical and pharmaceutical industries will increase significantly. Health care is an important area of social upgrading and spending, and as Ivorian become more affluent, the emerging middle class needs better medical conditions (26.4% of the 23 million inhabitants of Ivory Coast belong to the middle class). At the same time, the Ivory Coast is one of the highest population growth rates in the world.

#### **2.1.2 A Look at Ivory Coast the market: the pharmaceutical market is growing rapidly**

According to the International Finance Corporation (IFC), the healthcare market in the Ivory Coast will reach \$85 billion by 2050. It will continue to grow spurred by more domestic and foreign investment, with the market expected to reach \$60 billion by 2025. About \$11 billion to \$20 billion needs to come from private investment. Nearly half of the investment opportunities lie in improving medical conditions. The rest belong to the production and sale of medicines and medical supplies, medical insurance, and related training and education. More than 500,000 beds, 90,000 doctors, 500,000 nurses, and 300,000 community health workers will be added. It is necessary to upgrade production equipment and improve the market circulation system for pharmaceuticals and medical supplies.

#### **2.1.3 Rising Public-private partnerships**

Ivory Coast plan to provide a basic level of universal healthcare by 2050. To this end, governments have launched a public-private partnership (PPP) model for the healthcare industry. The so-called publicprivate partnership model (PPP, short for Public-Private Partnerships) refers to the management model in which the government's public sector cooperates with the private sector to provide general products and services, thereby realizing the functions of the public sector of the government.

#### **2.1.4 The pharmaceutical industry and medical devices**

Ivory Coast pharmaceutical industry is particularly favored by the public and private investment sectors. According to the government, about 90 % of the medicine used in Côte d'Ivoire are imported, and only 10% are made locally. Forty percent come from India and 20 percent from China, and the Ivory Coast's pharmaceutical industry accounts for only 10 percent of the share, but it is already growing steadily. According to the African Development Bank, the Ivorian pharmaceutical industry grows at more than 10% per year. Ivory Coast is working to reduce its dependence on imported medicines <sup>[1]</sup>. The import demand for medical devices in the countries varies greatly. Ivory Coast imported medical device products from

China mainly include implantable cardiovascular stents, surgical implantable prosthetic materials, spiral CT machines, etc. The import demand for medical devices in the Ivory Coast is not much different from Western developed countries. In addition, the more economically developed African countries also have a significant demand for pre-filled syringes. However, the tremendous demand in most African countries is still disposable medical devices, medical and health materials, and other popular products. These African countries urgently need relatively low-cost disposable syringes, selfdestructive syringes with reasonable safety, disposable medical latex gloves, disposable medical catheters, disposable (non-woven) surgical towels, surgical gowns, hospital gowns, bed linen, and other prevalent medical devices [2].

## **2.2 Health system in Ivory Coast**

### **2.2.1 Health policy**

The health policy of Ivory Coast as defined in the National Policy of Health Development aims to improve the state of health and well-being populations. This health policy constitutes a set of guidelines based on values and basic principles, aimed at influencing long-term decisions and actions to improving the health and well-being of populations. As such, it defines the objectives priorities and the Government's strategic orientations in the area of health. The result of broad consultations between the main players in the health development [3]. It provides for the creation of a favorable framework of reference in which the national response to health and health-related problems must be coherent, effective and rational.

### **2.2.2 Organization of the health system**

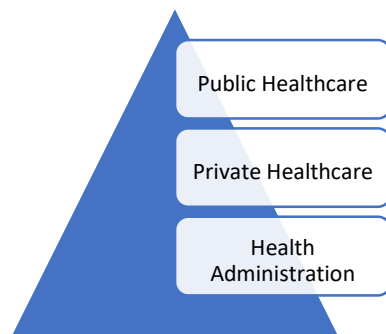


Figure 1. Ivory Coast health care system pyramid

The Ivorian health system includes public health care provision, private health care provision and the health administration. It is of the pyramidal type with three rungs and two slopes; one manager and the other provider. The health system is dominated by a preponderant public sector and a booming private sector, alongside which there is the traditional medicine which occupies a relatively important place. The public healthcare offer is organized according to a three-level healthcare pyramid. The primary level is made up of First Contact Health Establishments what are health centers, specialized health centers and health facilities [4]. The secondary level is made up of referral health establishments for first referral (general hospitals, regional hospitals), while the tertiary level is made up of referral health establishments for the second reference (university hospitals, specialized national institutes). The health administration includes the central services and the external services. The central services are made up of the Ministry of

Health and the Fight against AIDS office, the attached services and departments and general and central management.

The faith-based private sector, associations and organizations at community base also participate in the supply of care, especially at the primary level. Traditional medicine occupies an important place with more than 8,500 traditional healers identified by the National Program for the Promotion of Medicine Traditional. In Ivory Coast, the selection of health products is conducted by the central level more specifically the Department of Pharmacy, Medicines and Laboratories [5].

### **2.3 Chinese Input**

The joint fight against Ebola, Malaria, and now COVID-19 is an example of the cooperation between China and Ivory Coast in health care. Since the founding of New China, China – Ivory Coast medical and health cooperation has a history of nearly 60 years. It has always been an important part and part of China – Ivory Coast relations. In 1963, China dispatched the first medical team to support Africa to the Ivory Coast and Algeria. So far, it has sent at least 21,000 medical team members to 47 African countries, providing medical services to more than 220 million African people [6]. Medical teams have become the most extensive, effective, and long-lasting area of China-Africa health cooperation. China has 46 medical units and nearly 1,000 medical staff in Africa. They actively participated in the anti-epidemic action in the host country, preached the knowledge of epidemic prevention and control, trained local medical staff, and performed routine responsibilities such as medical treatment and saving people.

In addition to dispatching medical teams, China has also vigorously helped African countries like Ivory Coast to improve their medical infrastructure and aided the construction of hundreds of hospitals, health clinics, and anti-malarial centers. In the same way, China also helps African countries which include Ivory Coast to train medical staff, transfer medical technology, and support the countries to control infectious diseases such as yellow fever, schistosomiasis, cholera, malaria, AIDS, and Ebola hemorrhagic fever by providing scholarships or organizing training in local hospitals. Promote cooperation with African countries in a wide range of fields such as maternal and child health, cataract treatment, professional department construction, trade-in pharmaceutical products and related services, and investment in pharmaceutical factories. From 2014 to 2015, when the Ebola epidemic occurred in the West African countries such as Guinea, Sierra Leone, Ivory Coast and Liberia, China rushed to the rescue, dispatched 16 batches of clinical and public health experts with more than 1,200 persons to the three countries, and provided four rounds worth 750 million yuan to the affected areas. The emergency humanitarian material assistance has helped the three countries establish biosafety laboratories, Ebola treatment centers, and other health institutions to fight for the West African countries. The Chinese input played an essential role in defeating the Ebola epidemic, Malaria, and COVID-19 [7].

At present, China is assisting in constructing the emergency response center, information and training center, conference center, laboratory, library, news hall, office building, expert apartments, etc... After completion, it will become the first all-African CDCs with modern office and experimental conditions and complete facilities, which can effectively help the African Union (AU) play its role in the emergency



organization, coordination, and management in the medical and health field. The AU Commission had developed the African Pharmaceutical Industry Development Plan, which had offered preferential measures by several African governments to stimulate local drug production. In Ethiopia, Ivory Coast, for example, tax exemptions are granted to pharmaceutical investments/inputs imported by pharmaceutical joint ventures, including production equipment/instruments, QA equipment/systems, chemicals, raw material APIs, packaging materials, etc. Chinese pharmaceutical companies entering in Ivory Coast for investment and cooperation are seizing this development opportunity [8].

### **3. Weakness: Ivory Coast Medicine and Medical Supply Chain Plan**

Supply chain management is the active management of all activities involving purchasing, warehousing, distribution, information management, coordination, etc. in order to provide the right product, in the right quantity, in the right condition, in the right place, at the right time and at the right cost. The development of a **National Strategic Supply Chain Plan** provides a comprehensive response to many issues related to the supply and management of health products and ensures the performance of the supply chain. The Ivory Coast government from 2012 to 2015 developed a supply chain plan. The plan aimed to improve the health status of the population in a post-conflict context and had six (6) general objectives, 34 strategic axes distributed among fifteen structures and the financing needs amounted to \$11,103,659.29 around 7,621,538,434 CFA francs [9].

Thus, a results-based management methodology has been adopted, favoring a "project" approach with a project coordinator. In addition to strategic drugs and inputs, expanded the scope of planning to vaccines and blood transfusion-related products in the public pharmaceutical sector. The overall objective of the plan is to "Improve the availability and affordability of medicines, vaccines and other quality strategic inputs for all customers of public health facilities". In order to achieve this objective, 25 projects have been launched based on China – Ivory Coast healthcare partnership (Finished Pharmaceutical Product from China, Raw Material from China, Packaging, Manufacturer). The implementation of these projects will lead to 12 short-term outcomes (outputs) and 9 medium-term outcomes (effects). In a way quantitative, availability will have to be improved from 73% to 95% at the end of 2050 [10].

### **4. Weakness in the Medical Supply Chain Management in Ivory Coast**

#### **4.1 Process for Purchasing Health Products**

At center of the Public Health and Pharmacy of Ivory Coast, the supplier monitoring and evaluation process is not functional because the supplier performance measurement is not regular and the sharing of information is not systematic. The lack of coordination between the center of the Public Health and Pharmacy of Ivory Coast and the programs for the purchase of products causes storage problems. Vaccine purchases from China other countries are managed by the national institute of public hygiene, which uses purchasing agents. Lack of funding and disbursement difficulties result in sub supplies and delays in deliveries. The performance indicators of purchases are not defined.

#### **4.2 Storage and Management**

In general, the quality of storage decreases from the central warehouses towards the periphery for all channels. For the management of stocks of essential drugs, there is a low availability stock cards at the periphery (56%) and poor stock accuracy at all levels (67%). This leads to stock shortages (27%). The different of the logistics management information system are not harmonized and their management is vertical. Regarding vaccine storage conditions, only 20% of national institute of public hygiene branches meet 80% of adequate storage conditions. 40% of national institute of public hygiene branches have no emergency electrical equipment and the availability of safety equipment is minimal <sup>[11]</sup>. For the storage of blood transfusion products, good maturity has been observed at the central warehouse store with continuous availability of food electricity, infrastructure and cold room capacity. However the areas of storage of the central warehouse and the center of Abidjan are combined. The central warehouse has reported rationing of quantities delivered due to insufficient quantities received.

#### **4.3 Distribution**

At the intermediate level of the distribution chain, all health districts have at least one vehicle. However, the delivery of peripheral sites by the districts sanitation is not achieved in the majority of districts. The information on the distribution of drugs collected from districts that have benefited from vehicles in the context of strengthening the drug supply chain, reports the existence of distribution plans for the 21 beneficiary districts and the effectiveness of distribution in 18 districts. The distribution of vaccines is ensured by the national institute of public hygiene which uses its fleet and the services of a service provider. However, the provider's performance is not measured <sup>[12]</sup>.

#### **4.4 Laboratory**

In the supply chain of essential drugs and inputs, the laboratories of health establishments occupy an important place. At the level of national public health laboratory there are standard operating procedures, no laboratory in establishments at intermediate levels and devices. At the intermediate and peripheral levels, the spaces dedicated to the laboratory are not adapted. In these laboratories, there is no storage space for hazardous products. The management standards for these dangerous products and safety equipment are not available. The storage capacities of the blood transfusion center and blood transfusion coil laboratories are not sufficient and the control of reagents used for typing and control of blood samples is not realized <sup>[13]</sup>.

#### **4.5 Logistics Management Information System**

Logistics information in Ivory Coast is characterized by the absence of a system National Integrated Logistics Management Information System. The availability of logistical information, which is a prerequisite for any planning in medicine is gradually improving. The table I below shows the key performance indicators :

Table 1 Ivory Coast Logistics Information

Key performance indicator	Pharmacies of hospitals	Pharmacies of District

Percentage of facilities reporting monthly of the study period.	81%	80%
Percentage of facilities that submitted a report with all the three essential logistics data (stock available, the consumption and losses and adjustments)	80%	88%
Average completeness rate of consumption data	95%	100%
Average rate of completeness of losses and rectifications of data	90%	99%
Average rate of completeness of data on stocks on hand and usable	99%	100%
The readiness rate	98%	97%

Source: National strategic chain plan supply of products pharmaceuticals and inputs strategic & data (PNSCA) 2016-2021.

#### **4.6 Solutions**

The challenges identified at the purchasing level are related to the purchasing mechanisms and the financial capacity whatever the source (cost recovery, state budget). To this must be added the lack of follow-up of suppliers by key indicators of performance regularly measured and used for decisionmaking. Indeed, the international standards require that purchases be made independently by the local purchasing centers according to a defined procedure and that they have sufficient funds. Despite the institutional reform that led to its autonomy in management and operation, public health pharmacy of Ivory Coast does not purchase commodities from health programs.

In addition, late and sometimes insufficient collection of receivables presents a risk important for its proper functioning and the full availability of health products. With regard to the national institute of public hygiene, the insufficient budget allocated to the purchase of vaccines jeopardizes their continued supply. Strengthening the supply chain for drugs and other inputs strategies is a lever for achieving the objectives of the national health development plan, in particular the availability and accessibility to drugs and other strategic inputs for quality. The national strategic plan for the pharmaceutical supply chain with its new methodological approach will facilitate the appropriation, coordination and its financing, especially since the projects were developed during a participatory and consensual process. All local stakeholders and technical and financial partners should use plan as a roadmap to improve the availability of drugs in Côte d'Ivoire.

#### **5. Conclusion and Expectation**

Strengthening the supply chain for medicine and other inputs strategies is a lever for achieving the objectives of the government, in particular the availability and accessibility to drugs and other strategic inputs for quality. Despite, the notable achievements produced by the partnership between Ivory Coast and China, major challenges remain to be raised. Among the achievements, we should note the possibility of measuring indicators, the availability of information, the acquisition of vehicles for distribution, for the



districts of health and bringing pharmacies in public establishments up to standard in Ivory Coast. The current challenges are numerous among others, the insufficiency in the appropriation of the projects, the lack of regular analysis of data for decision-making, concentration of warehousing and product distribution services as well as the lack of a system integrated national logistics. For its part, the Ivory Coast is not only waiting for the Chinese investment or medical supply from China, under contrary is working on improving its local healthcare manufacturing, also favorite more future investments in activities labor-intensive manufacturing, especially as wage costs increase today much faster in China than in Africa, the aims to increase the mutual benefits that flow from Ivory Coast – China cooperation. All local stakeholders and technical and financial partners will have to use the government supply chain plan as a roadmap to improve the availability of medicines and medical equipment in Ivory Coast.

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