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Nasopharyngeal Samples Management Strategy During the COVID-19 Pandemic: Experience of the Pasteur Institute of Côte d'Ivoire (2020)

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Authors' contributions

This work was carried out in collaboration among all authors. Author DKO wrote the protocol, the first draft, and review the manuscrit. Author GKB help to the traduction in english and, has review the manuscrit. Author DKM has help to the protocol writing author KKI has review the manuscrit, author SKSM has help to the writing and to the review, author OKA has help to the review author KKS help to the Investigation author YBV help to the investigation author AS has help to the writing of the methodology and the reviewing, author DM has help to the conceptualization, to the writing, and the review of the manuscrit. All authors read and approved the final manuscript.

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ABSTRACT

Medical testing laboratories are an essential link in the efficient management of infectious diseases by the identification of the pathogens involved. However, the arrangements for their operation may appear more difficult in times of health crises and raise multiple issues that may compromise the usual level of quality assurance of biological analyses and the response to needs. The smooth running and control of laboratory activities in a health crisis situation requires the implementation of a management system that allows the federation of all available energies. We report here on the experience of the Pasteur Institute of Côte d'Ivoire, in charge of nasopharyngeal samples management during the COVID 19 pandemic, describing the assessment of pre-analytical activities in the first quarter of the crisis (March to May 2020). We then present the implemented strategy and the results obtained from June to September 2020. This article proposes a framework for sharing experiences to contribute to a better preparation of the pre-analytical phase of laboratory samples during health crises.

Keywords: Corona virus disease 2019; documentary system; Pasteur Institute of Côte d'Ivoire.

1. INTRODUCTION

Coronavirus type 2 (CoV-2) is an emerging pathogen that has attracted the interest of countries around the world due to the extent of its previously unknown spread [1,2]. This new virus appeared for the first time in the city of Wuhan, Hubei Province, China, in late December 2019, and spreaded rapidly, involving other parts of China and world [3,4].

The sudden and explosive nature of the pandemic forced each country to urgently put in place a response plan to address the crisis [5].

Côte d'Ivoire is one of the west african countries. It had its first case of severe acute respiratory syndrome due to coronavirus type 2 (SARS-CoV2) on March 11, 2020 [6].

At the beginning of the crisis, ivorian authorities set up a scientific committee to assist in decision-making.

As a matter of fact, two recommendations have been made to help reduce contamination. These are setting up thirteen sample collection centers for Coronavirus 2019 (COVID-19) in Abidjan, forty-eight rapid intervention teams in health districts, and ten central rapid intervention teams linked to national public hygiene institute. Real time polymerase reaction chain (RT-PCR) was recommended for biological analysis of naso-pharyngeal samples from suspect patients.

The implementation of this management system led to a very significant increase in the number of samples taken from May 2020 in the city of Abidjan, which is the "hot spot" of the epidemic and a considerable influx of samples to the Pasteur Institute of Côte d'Ivoire (IPCI), which was responsible for centralizing and biologically diagnosing of suspect nasopharyngeal samples.

At the beginning of the pandemic, the responsibility for RT-PCR tests was exclusively entrusted to the national reference center (NRC) for respiratory viruses of the institute's department of epidemic viruses, because since 2006, by interministerial order N° 393 of June 21, 2006, this CNR has been in charge of diagnosing respiratory viruses in nasal and oropharyngeal specimens in Côte d'Ivoire. However, the assessment of the pre-analytical activities of the samples after three months of operation in the emergency context of the health crisis highlighted several difficulties that led to the creation of an autonomous multidisciplinary group for the pre-analytical management of nasopharyngeal samples.

The objectives of this document are to present the assessment of pre-analytical activities during the first quarter of the pandemic at Covid 19 in Ivory Coast (March to May 2020), the strategy put in place to meet the needs, the results obtained from June to September 2020 and the challenges to be met.

1.1 Assessment of Pre-Analytical Activities from March to May 2020 in the Context of Health Emergencies

1.1.1 Context

When IPCI is faced with an epidemic situation in Côte d'Ivoire or in the west african region, the concerned national reference center (NRC)

carries out the laboratory diagnosis. The NRC is therefore in charge of the pre-analytical phase (reception and processing of samples), the analytical phase and the post-analytical phase (data management and archiving). This is why, from January 2020, after the WHO confirmed cases of COVID 19, the NRC in charge of influenza and respiratory viruses had to organize itself to face this new public health problem.

This NRC carried out all Covid19 tests during the period from March to May 2020 in Côte d'Ivoire. However, the control of the pre-analytical phase was not efficient in the face of the difficulties related to the mass effect of the health crisis. These difficulties are not specific to it, but are the hallmark of any health crisis of natural or technological origin, being on a local, national or international scale [7].

1.1.2 Difficulties

The problems encountered during the pre-analytical phase were related to crampedness of the room dedicated to pre-analytical activities, limited number of personnel in charge of the activity and inadequacy of the working equipment (cold chain for adequate conservation of samples, number of tubes for aliquoting, personal protective equipment, disinfection equipment, logistics, etc.). Other needs also arose, namely: computer software with an internet connection, for samples collection centers traceability, and activities monitoring, as well as limited number of data entry operators. These difficulties had a negative impact on the quality [8] of pre-analytical phase activities and satisfaction of needs in spite of hard working. The main problem was the delay in transferring samples from the receiving station to the laboratories, which resulted in a significant storage of containers, samples to be decontaminated and sorted, and a significant number of non-compliant, rejected or lost samples. These malfunctions resulted in a lengthening of the time required to avail results, with a timeframe of 72 hours for samples taken in Abidjan, and one week for samples from remote areas. Faced with this situation, IPCI reorganized itself by implementing another strategy.

2. METHODOLOGY

In early June 2020, the IPCI managing board took the decision to create an autonomous Group for sample reception sorting, decontamination and aliquoting (GRTDA) of patients suspected to be suffring from COVID-19 disease.

The latter is a transversal and multidisciplinary team composed of medical biologists, molecular biologists, microbiologists and biochemists; all of them being staff members of the institute along with a senior inspector, a support technician, and doctoral students. Why such a multidisciplinarity? At this stage of the pandemic, it was necessary to federate all available and volunteer energies to get all IPCI staff involved in the fight against this severe pandemic. Furthermore, in such a situation, there is a crucial need for researchers to put together their energy and skills to give effective and daily response in delivering diagnostic result.

As soon as the group was created, a documentation system had to be urgently put in place to keep the team running 24 hours a day, 7 days a week.

2.1 Organization of the COVID-19 Staff Personnel

The following responsibilities were defined : the role of the coordinator is to plan, organize and control activities of receiving, sorting, decontaminating and aliquoting COVID-19 samples, the assistant coordinator assumes the duties of the coordinator in case of absence.

Then, the following operational responsibilities were also assigned : management of non-conformities, and communication with national public hygiene institute and COVID-19 centers for resumption of non-conforming samples. Management and transfer of samples for storage at the biobank, hygiene management of premises, decontamination and storage of packaging.

Another step of the Organization was group capacity buiiding.

Hence, group members were trained in biosecurity and biosafety by the IPCI's health and biosecurity department, which is qualified thereof.

2.2 Premises and Material Management

Premises were adapted by creating reception spaces for a large number of containers and samples in order to meet personnel protection requirements.

High throughtput equipment was made available to the group: computer software, type II safety cabinets, a cold chain, internet facility.

2.3 Documentary System

Data management tools have been developed at all stages of samples pre-analytical phase (reception, aliquoting, transmission, management of non-conformities, orders).

2.4 Process of Group's Activities

To be effectively opérational, the group's activities were organized according to the following flowchart (Fig. 1).

3. RESULTS

The quality of pre-analytical phase activities have been improuved at several levels.

3.1 Sample Follow-Up Outcome

Due to the put in place organisation, the following results were obtained: better traceability and tracking of samples using barcode and sotfware, management of non-conformities (not mentionned in this article), significant depletion of non conformities, decrease in rejection of samples and sample loss.

3.2 Results Reporting

Delivery deadline was shortened by less than 48 hours as of August 2020.

3.3 Communication

Notification of negative results by text message ; uploading of certificate of analysis for travelers through the application "attestationcovid.ci".

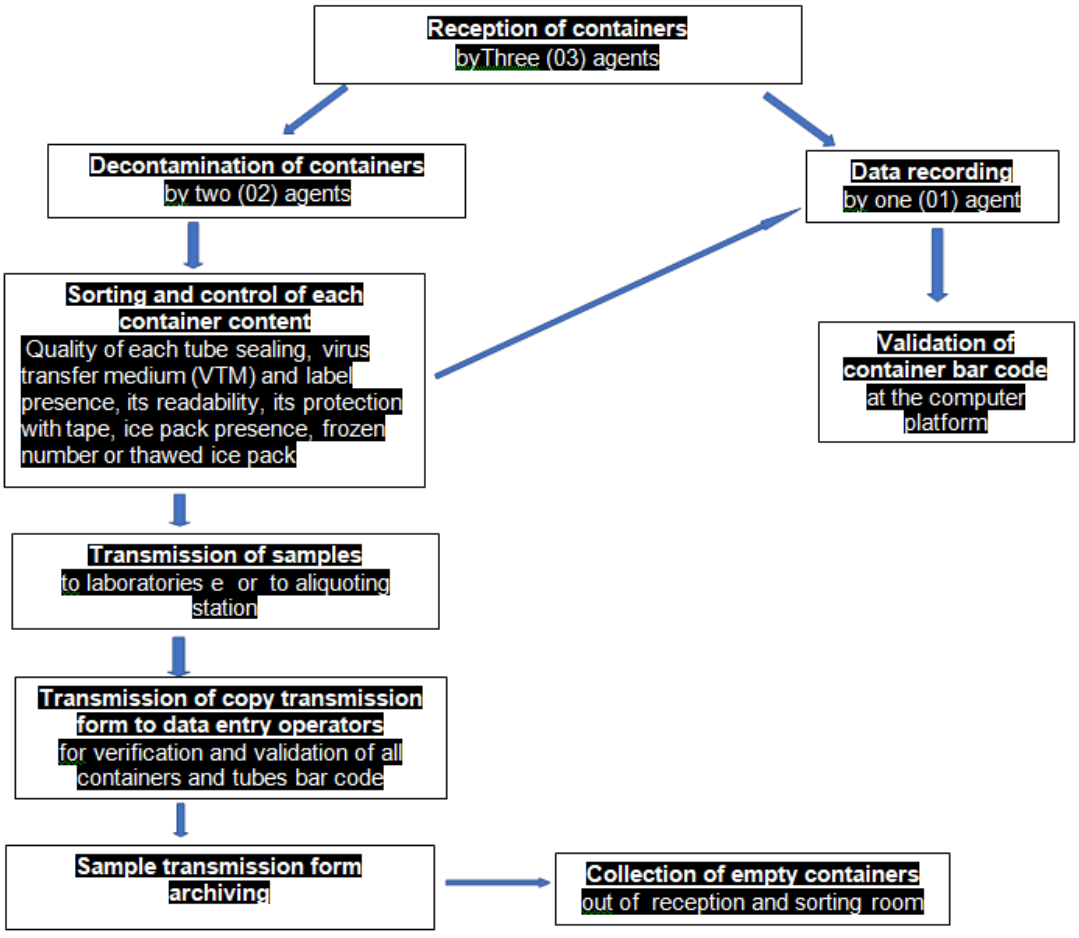

Fig. 1. Processes for sample receiving, sorting, decontamination and aliquoting group activities

Aside this, the infectious diseases department of the Treichville university teaching hospital takes care of COVID-19 positive patients.

3.4 Capacity to Receive a Larger Sample Flow

The organization system came up with better storage of samples to be sent to the laboratory, aliquoting station or the Biobank of Pasteur Institute of Côte d'Ivoire.

3.5 Sample Reception Trend

An exponential growth in the number of suspicious COVID-19 samples was recorded from March to July, which represented the pandemic peak. The decrease in the number of samples in August can be explained by the decrease in the number of travelers. The increase in the number of samples received in September may be due to the high demand that occurs at the beginning of school and academic year (Fig. 2).

4. COMMENTS AND CHALLENGES

The health crisis of COVID-19 disease caused unusual conditions at Pasteur Institute of Côte d'Ivoire, and raised multiple problems at level of the quality of the pre-analytical phase of the nasopharyngeal samples due to the large volume of samples to be processed.

One of the main problems faced by the multidisciplinary group (GRTDA) in the reception of nasopharyngeal samples, was to evacuate the stock of samples that had built up over time and to avoid storing the new samples received before they were sent to the laboratories. The reorganization of the human and material resources and the implementation of a documentation system adapted to the situation of the health crisis made it possible to deal with this problem. The resolution of this problem has contributed to the reduction of the time required to provide results of biological analysis of samples, which has been reduced from an average of 72 hours for samples from the city of Abidjan to less than 48 hours from August and then to 24 hours in September. For samples from cities with regional hospitals, the decision was made to perform COVID-19 tests at TB centers that have a Gene-Xpert. This pooling of resources has reduced the time required to obtain results from 7 days to a maximum of 72 hours.

In other countries, the turnaround time for biological analysis of samples from outbreaks far away from reference centers has been improved by the deployment of mobile laboratories. This method should complement the strategy for managing specimens from reference centers during pandemics to improve the quality of biological test delivery.

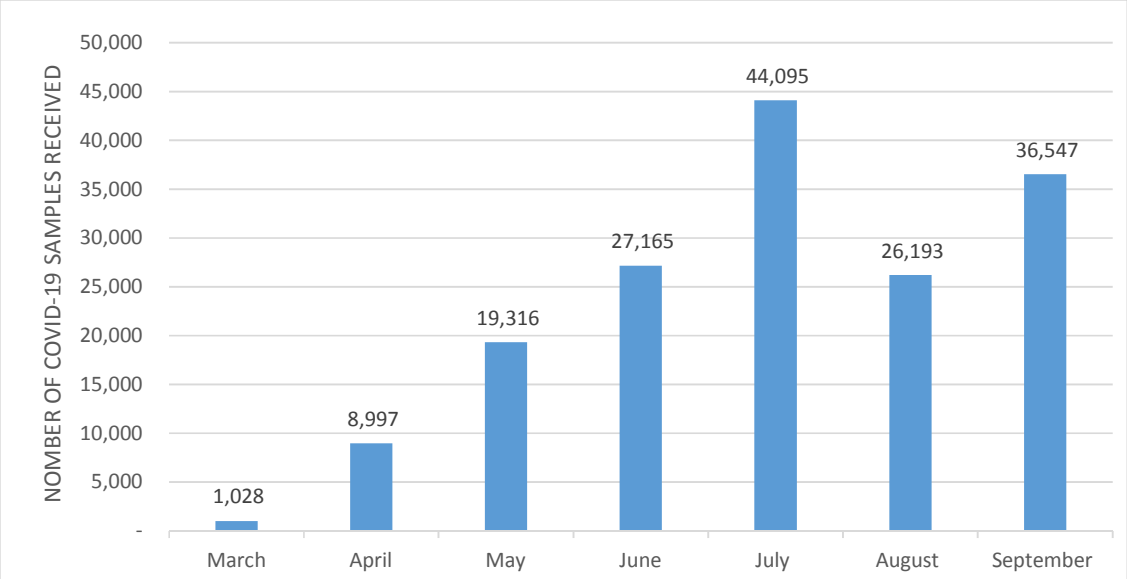

Fig. 2. Evolution of the number of suspect samples of Covid 19 received from March to September 2020 at the pasteur institute of Côte d'Ivoire

Indeed, mobile laboratories are very useful in countries where field data communication systems are not well developed. Also, the quality of the analyses of these mobile laboratories is superposable to those of the reference laboratories [9].

These mobile laboratories have been used in some African countries to deal with epidemics due to emerging pathogens. These include Angola in 2005 to contain an outbreak of Marburg virus disease [10], the Democratic Republic of Congo in 2007 [11] and Mali in 2014 during the Ebola virus epidemic [12].

They bring the populations of remote outbreaks closer to reference laboratories by allowing biological analysis of their samples in a few hours [13].

The quality of the follow-up of biological analyses of samples has also been improved by better traceability of nasopharyngeal swabs with the introduction of barcodes and the "tracetube.ci" application (internet). However, efforts must be continued by strengthening the internet connection to ensure permanent monitoring of samples by all actors involved in the sample management process and by the organizational hierarchy. This internet-based laboratory monitoring strategy is also used in Burkina Faso for diseases with epidemic and epizootic potential surveillance [14].

With respect to the management of non-compliant samples, the number of rejected nasopharyngeal samples has decreased considerably thanks to the sensitization and training of COVID-19 sampling center personnel by Pasteur Institute of Côte d'Ivoire and the National Institute of Public Hygiene (INHP) biosafety and biosecurity unit. However, efforts must be continued to optimize the management of non-conformities by installing a software for managing non-conformities in the "tracetube.ci" application. This software will allow the non-conformity manager to communicate directly the references of non-conforming tubes to all actors concerned by abnormal samples, in order to accelerate corrective actions and reduce the number of complaints.

The quality of communication between the Pasteur Institute of Côte d'Ivoire and persons requesting diagnosis of COVID19 has also been improved by transmitting negative results by SMS and issuing a certificate of analysis for travelers through the application "attestationcovid.ci". Efforts must be continued by the implementation of a litigation department for the rapid management of claims at the application "tracetube.ci".

The resolution of all these problems recorded during the first quarter of the health crisis has allowed the daily capacity of the pre-analytical management of nasopharyngeal samples to increase from 623 samples in May to 906 in June and 1422 in July 2020.

The first feedback from Institut Pasteur of Côte d'Ivoire, faced with the sudden onset of the COVID-19 pandemic from March to May 2020, is similar to the situation experienced by medical analysis laboratories in France. Indeed, a report published by the French Society of Microbiology (SFM) showed that France was insufficiently prepared for the COVID-19 pandemic, with considerable human, organizational and economic consequences [7]. However, French laboratories quickly adapted to the situation by reorganizing themselves through local rearrangements, reallocation of human resources, and pooling of their high-tech materials and equipment [15]. The advantages that enabled France to control the COVID-19 health crisis situation more quickly were the high efficiency of their system of communication of field data to public health bodies and decision-making centers, whether local, regional or national [16]. This allowed them to ensure proper vigilance and to allow the executive to take adequate public measures quickly [7].

5. CONCLUSION

The health crisis due to the SARS-CoV-2 pandemic raised multiple issues in the pre-analytical management of nasopharyngeal swabs. The Pasteur Institute of Côte d'Ivoire reacted positively by pooling all its energies, and developing a documentation system adapted to the crisis situation. This allowed to improve results of pre-analytical management of nasopharyngeal suspected of COVID-19 swabs and meet community needs. This experience showed that better running and control of the pre-analytical management of nasopharyngeal swabs during the COVID-19 pandemic requires management based on teamwork, reorganization of material resources and implementation of an adequate documentation system. Yet, the SARS-CoV-2 pandemic continues, and several other challenges remain. The experience of Pasteur

Institute of Côte d'Ivoire showed effectiveness of its strategy against difficulties related to the mass effect of the COVID-19 health crisis and should help other structures to set up and manage pre-analytical phase during health crises caused by emerging pathogens.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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