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PRACTITIONER'S REPORT

Implementation of Good Laboratory Practices (NIT-DICLA-035, Inmetro) in a technological platforms network: the Fiocruz experience

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Abstract The technological platforms network (TPN) of the Oswaldo Cruz Foundation was developed as the result of the need to provide technical and scientific services to the Brazilian public health and health research networks through the use of high cost, state-of-the-art, multiuser equipment. In order to improve the quality of the services offered, a quality management system (QMS) was implemented in a group of subunits of the TPN. To achieve the planned objectives, a review of all the existing guidelines was carried out first, which led to the choice of a Brazilian guideline: Inmetro NIT-DICLA-035, "Good Laboratory Practices" (GLP). The next steps were the choice of the platform subunits (Pilot Project), the drafting of relevant documentation, and the creation of a quality assurance structure as well as other activities. It was clear that a proper interpretation and understanding of GLP in these platforms could make a difference in the efficacy and effectiveness of the system defined. The expertise gained through the implementation of QMS in the Pilot Project has enabled GLP implementation in the other TPN subunit platforms.

Keywords Quality management · Research and technological development · Technological platforms · Good laboratory practice

Abbreviations

CAPES	Coordination of Higher Education
CNPq	National Council on Scientific and Technological Development
CPqAM	Aggeu Magalhães Research Center
DECIT	Department of Science and Technology
EU	European Union
FAPERJ	Foundation to Further Research in the State of Rio de Janeiro
FDA	Food and Drug Administration
Fiocruz	Oswaldo Cruz Foundation
GLP	Good Laboratory Practices
INMETRO	National Institute of Metrology, Quality and Technology
ISF	Federal Sorotherapy Institute
OECD	Organization for Economic Co-operation and Development
PDTIS	Program for Technological Development of Health Products
PDTSP	Program for Technological Development of Public Health Products
QAS	Quality Assurance Systems
QM	Quality Management

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QMS	Quality Management Systems
R&D	Research and Development
SOP	Standard Operating Procedures
TPN	Technical Platforms Network
WHO	World Health Organization

Introduction: the historical context of the Oswaldo Cruz Foundation

The Oswaldo Cruz Foundation was created by the Brazilian government in 1900 and was initially named the Federal Sorotherapy Institute (ISF). During that epoch, its first challenges were dealing with the successive epidemics of yellow fever and variola that had been devastating the population and driving investment away from the region. Thus, the ISF was established in Rio de Janeiro, and its principal mission was the combat of grave Brazilian public health problems [1]. In 1970, the reorganization of this institution as a foundation, with the same noble mission, was the origin of the Oswaldo Cruz Foundation (Fiocruz). Today, this entity has its headquarters on the Manguinhos Campus in the city of Rio de Janeiro, where the techno-scientific and techno-administrative units are located. Additional units are located in the boroughs of Flamengo and Jacarepagua in the city of Rio de Janeiro, as well as in regional centers in various other states.

Since its creation, Fiocruz has strived to link the areas of science, technology, and innovation in the field of public health through carrying out activities, which include: developing research; offering services to hospitals, clinics, and reference laboratories; fabricating vaccines, drugs, reagents, and diagnostic kits; controlling the quality of products and services; and implementing social programs, among others [2]. The creation of Fiocruz was closely linked to the beginning of the structuring of Brazilian science. Outstanding accomplishments, such as the campaign against yellow fever and the discovery of Chagas disease, transformed the then Federal Soropedic Institute into the Oswaldo Cruz Foundation, an organization that has strongly contributed to the birth and development of science in Brazil [3].

Fiocruz is considered a multidisciplinary public health center, and its activities on the national and international level have become a world reference in the area of science and technology in health. There are five sector programs that it participates in, following the objectives and guidelines of the federal government: science, technology and health innovation; pharmaceutical assistance and strategic supplies; betterments in health work and education; surveillance and prevention of risks associated with the production and consumption of consumer goods and services, and surveillance, prevention, and control of diseases and harm [2].

The Program for Technological Development of Health Products and the Technological Platforms Network

The needs established by modernity had led to the creation of the Brazilian Law of Innovation in 2004, which helped fuel a growing interest in processes that could help generate innovative products and services and also were the principles responsible for the creation of the technology programs at Fiocruz [4]. Thus, two technology development programs were created by the presidency of Fiocruz: the *Program for Technological Development of Health Products* (PDTIS) and the *Program for Technological Development of Public Health Products* (PDTSP). These initiatives are intended to reinforce the Brazilian global position in the areas of applied research and technological development in public health. In addition, these inductive programs permit and engender communication between the various sectors of technological development, from basic research to the fabrication of health supplies [5].

The PDTIS is a technology-inducing program at Fiocruz, promoting and articulating multidisciplinary cooperation. The structure of the program is based on interorganizational cooperative networks that connect the techno-scientific and production units of Fiocruz with the ultimate purpose of delivering quality products and processes to Brazilian society. The cooperative network structure model was adopted to motivate researchers to work together to achieve common objectives and to optimize the use of human and financial resources [6].

Under the auspices of this program, five cooperative networks were created: (a) the genomics and protemics network; (b) the diagnostics network; (c) the drug development network; (d) the vaccine development network; and (e) the technological platforms network (TPN).

The TPN was founded because of the need to facilitate multiuser access to high-cost, state-of-the-art equipment. Through the use of TPN, Fiocruz has optimized its resources and improved research and development (R&D) across the whole institution. Today, the network includes 12 technological platforms and 40 platform subunits located in the Brazilian states of Rio de Janeiro, Pernambuco, Minas Gerais, Paraná, and Bahia [7].

With the goal of offering services that are both traceable and reliable, the subarea of quality management (QM) was created within the framework of TPN.

The QM area induces and implements quality assurance systems (QAS) and thus guarantees the traceability and reliability of all data generated by assays and research carried out. Its first activity was establishing the scope of

the TPN, through which the services and analyses to be offered were carefully defined and detailed, enabling the implementation of QM guidelines.

This study details the activities developed in the subarea of QM established in the TPN framework, more specifically in the work developed in the Aggeu Magalhães Research Center, a regional Center of Fiocruz located in the state of Pernambuco. The methodological stages that were developed within the above-mentioned scope are best described in the methodology section.

The Aggeu Magalhães Research Center—Fiocruz Pernambuco, Brazil

The Aggeu Magalhães Research Center (CPqAM) was founded in 1930, beginning with the creation of an Obituary Verification Service (SVO), by a group of investigators interested in researching helminthic and tropical diseases in the north and the northeast of the country [8].

In 1970, during a series of changes in the Ministry of Health, the Center was incorporated with Fiocruz. The core mission of the CPqAM is the development of systematic research into diverse fields of public health [9], being a reference in the control of mosquito-borne diseases, schistosomiasis, filariasis, leishmaniasis, Chagas disease, bubonic plague, and hanta virus for the Ministry of Health. In addition, it is responsible for the development and validation of molecular and immunological diagnostic tests for schistosomiasis, malaria, leishmaniasis, and tuberculosis and is a collaborator in environmental health for the World Health Organization (WHO) [10].

The main reason for the choice of CPqAM for this study was that there was already an Integrated Nucleus of Technologies present : high-performance equipment had been installed and services in the areas of DNA sequencing, real-time PCR, flow cytometry, analytical ultracentrifugation and confocal, and scanning and electronic transmission microscopy were being carried out. Since 2008, four pieces of this equipment have been part of the TPN, constituting the subunits of technological platforms of confocal microscopy, DNA sequencing, flow cytometry, and real-time PCR.

The necessity of implementing quality management systems in research and technological development in health

Today, it has been well established that the implementation of quality management systems (QMS) is a crucial factor for achieving continuous quality improvement of services offered. In relation to laboratories and public health centers, the importance of quality in their operations has been nationally and internationally recognized, as laboratories that practice QM produce reliable and relevant results, in addition to gaining better cost benefits for the results supplied. To reinforce the value of this coverage, the WHO has recommended the establishment of quality practices in the public health area, whether laboratories are involved or not [11].

Laboratories that are directly or indirectly responsible for R&D carryout stages of investigative methodology and are constantly searching for new and innovative procedures and processes, in a push to stimulate creativity and promote continuous evolution. Research activities are generally focused on basic research or applied research. On the other hand, technological development consists of four stages: project viability; prototype fabrication; validation/standardization of processes; and the optimization of conditions [12].

Over the last few years, there has been a rising interest in what has been referred to as strategy development for direct application in the implementation of QMS for R&D activities, research laboratories, and research centers. This mobilization is justified because of the need to comply with national and international quality standards established by certification and accreditation entities. Many times, this compliance is directly linked to processes involving global negotiations that require standardization [13].

Effective laboratory QMS promotes the traceability and reliability of all results obtained, and the consequent optimization of time and investments related to the execution of these procedures [14]. In addition to the legal aspects related to the implementation of QMS in R&D environments, Camman and Kleibohmer [12], describe other factors in their study that justify this importance. These factors include: (1) R&D, including basic research, when carried out at a site, should be comparable to research carried out at any other R&D site; (2) the greater the investment in quality in a product based on R&D, the greater will be its ability to attain market share; and (3) more and more national and international research institutes are demanding QMS implementation.

Data from the literature have shown that, when considering the implementation of QMS in their activities that involve R&D, scientists in some research centers, specifically those with an academic profile, show great concern, as well as a certain incredulousness, not only for the activities inherent in the implementation process, but also for the consequences generated by the modifications and adjustments proposed. Some of them argue that the rigidity implicit in a formal QMS is an excessively normative constraint that can stifle scientific progress, reducing creativity in research while increasing bureaucracy [12].

Actually, there are no specific guidelines that are destined for, or apply to, R&D laboratories, and very probably, this is a negative factor on the pressure for QMS in R&D environments. However, there are some guidelines in worldwide circulation, such as ISO/IEC 17025, used in laboratories for trials and/or calibration [15], ISO 15189, utilized in clinical analysis laboratories [16], and Good Laboratory Practices (NIT-DICLA-035/GLP), applicable to non-clinical research [17] that can be employed with a guarantee of success, considering some adaptations necessary for R&D activities.

Objective

The objective of this study is to describe the process of implementing a QMS in a technological platforms network, illustrating all the stages involved in the process.

Methodology and results

With the aim of facilitating the logic of the process of implementation, an action plan was created, in which the stages were defined and the main activities to be controlled were established. Table 1 illustrates the plan.

It is important to emphasize that the activities set out in items 1, 2, and 3 were applied to all the TPN platform subunits, while the activities set out in items 4,5,6, 7, and 8 were only developed in the group of platform subunits where the Pilot Project was implemented.

Choice of guideline to be implemented

The choice of an adequate guideline is a determining factor in the application of a QMS in laboratories or health centers. The coverage chosen should take into account the scope of practices that corresponds to the type of services offered. Through a preliminary evaluation, the regulations that most closely cover the scope of analyses offered by the TPN were defined as being the reference documents of Good Laboratory Practices (GLP) edited in Brazil by the National Institute of Metrology, Quality and Technology (Inmetro). GLP is a quality system concerned with the organizational process and the conditions, under which non-clinical health and environmental safety studies are planned, performed, monitored, recorded, archived, and reported [17].

During the process of choosing the guidelines for quality management to be implemented in the platform network, the coordinators decided to opt for the utilization of a standard that would be best for the range of services offered on the network as well as one that would be well accepted by the researchers responsible for the platform subunits. The GLP documents are applied to each research or study project, in this way making it unnecessary to have a general policy for all the works in process at the laboratory as preconized in other laboratory quality guidelines (ISO17025 and ISO15189). In addition, as there are no global regulations or standards for R&D environments, the GLP guidelines are utilized for this, as the practices preconized in GLP permit greater flexibility to be incorporated by the professionals involved.

The documents that regulate GLP were created in the USA during the latter half of the 1970s, in an effort to improve poorly executed practices in research and development that had been observed in the laboratories responsible for carrying out analyses for the pharmaceutical industry. Initially adopted by the Food and Drug Administration (FDA), the standards prescribed sought to organize and better administer all analyses involved, in addition to establishing standards for carrying out non-clinical studies [18].

In 1981, the Organization for Economic Cooperation and Development (OECD) also published the principles of

Table 1 Action plan employed in the implementation of a quality management system (QMS) in the technological platforms network /PDTIS

Stages	Main actions
Evaluation and choice of standards to be implemented	Evaluate extant national standards and compare them with the scope of services/analyses offered by the TPN
Internal training program	Specialized training for all TPN professionals
Choose platform subunits for the process to start (Pilot Project)	Evaluate the complexity and demand for analyses, internal organization of subunits, and the availability of existing staff
Organization and definition of GLP positions	Define professionals according to the positions set out in TPN
Design and elaboration of pertinent documentation	In accordance with the requirements of the guideline, establish which documents should be designed, including the administrative and technical areas
Structure Quality Assurance (QA)	Define the professionals involved and QA related activities
Structure technological park of the technological platforms network	Inventory equipment extant and create an equipment calibration and maintenance program
Evaluate through internal inspections and improvement programs.	Carry out internal inspections and set up improvement programs

GLP recommending the documentation to OECD member countries. This initiative caused the GLP principles that had been edited by the OECD to assume international status, and in 1986, the GLP directives of the OECD were adopted by the European Union (EU) [19, 20].

At the beginning of the 1990s, Brazil started to strive on a national level to adequate itself to the unfolding world scenario. On a country level, Inmetro was responsible for GLP practices. Some actions were carried out, including the creation of the Inmetro GLP Technical Commission, GLP training programs, and the formation of GLP inspectors. Some GLP guidelines were issued in the country, and today, the GLP standard in use in Brazil is version 01 of the NIT-DICLA-035 that was issued by Inmetro in 2009.

It should be noted that the Brazilian version of GLP principles is similar to the one published by the OECD in that it is also subdivided into ten main items. These items, when evaluated as a group, define a system of quality management that covers the organizational process and the conditions for carrying out the planning, development, monitoring, registration, archiving, and reporting for non-clinical health and environmental safety studies (Fig. 1).

Internal training program

Once the choice standards had been defined, an internal training program was developed. The objective of this program was to train all professionals directly or indirectly involved with GLP. In line with this program, four training courses were offered, all of them based on the NIT-DICLA-035 guideline and its complementary documents. Table 2 shows the training courses that were offered and the respective hours for each one, as well as a brief explanation of the objectives.

Starting with the four training programs offered, around 280 professionals were prepared, among them: permanent staff of the institution; graduate and post-graduate students; interns, as well as outsourced employees. The coverage of the program reached all Fiocruz techno-scientific units that were responsible for allocation of technological platforms, including regional centers.

As a strategy for the coordination of PDTIS and TPN, the training programs were offered to all the professionals who worked directly or indirectly with TPN, even though initially the implementation of GLP was only in a limited number of platform subunits (this was the Pilot Project that will be more fully explained in "The Aggeu Magalhães Research Center – Fiocruz Pernambuco, Brazil"). Through the adoption of this strategy, all professionals involved were initially sensitized and prepared for the moment in the future when GLP would be implemented in all platform subunits as the institutional policy for all laboratory research activities.

Choice of platform subunits where the process was begun (Pilot Project)

Since the scope of operations, and mainly the type of analyses, carried out on existing GLP platforms are quite distinct, we chose a group of platform subunits to begin the implementation process. The goal of this strategy was to determine what would really have to be done to carry out implementation over the whole network, utilizing

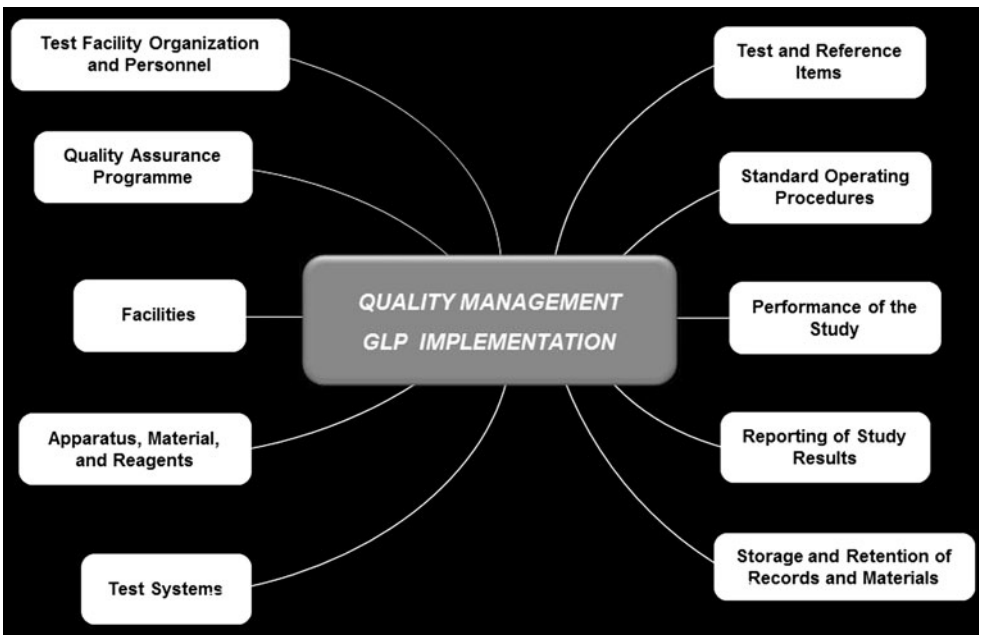

Fig. 1 Principles of Good Laboratory Practices (GLP)

Table 2 Training carried out for guideline NIT-DICLA-035 (GLP, Good Laboratory Practices) compliance under the Internal Training Program for Quality Management offered by TPN

Training	Course time (h)	Goals
Good Laboratory Practices: Introduction to the NIT-DICLA-035 guideline and related documents, 2008, Rio de Janeiro	8	Attune all professionals involved, mainly to the scope of the guideline and its nomenclature
Good Laboratory Practices for quality managers, 2008 Rio de Janeiro	16	Prepare professionals to be quality managers
Good Laboratory Practices) for study directors, 2008, Rio de Janeiro	16	Prepare professionals to be study directors
Good Laboratory Practices: Introduction to the NIT-DICLA-035 guideline and related documents, 2008, Recife	4	Attune all professionals involved with the platforms allocated to the Aggeu Magalhães Institute (Fiocruz-Recife) mainly to the scope of the guideline and its nomenclature

successful experiences and discarding those that were not in accord with the existing routine. The idea was to establish a Pilot Project and use it as a model for the other subunits.

There were some determining factors for choosing the platform subunits that would take part in the Pilot Project, and starting from them, a prioritization level for implementation initiation was established. The following criteria were considered: (1) platform subunits that offered analyses with a medium or low complexity level; (2) platform subunits with reduced analysis demand; (3) platform subunits with a well-defined internal organization; (4) the availability of current staff; and (5) explicit administrative support for the establishment and implementation of activities related to quality management.

After this evaluation had been carried out, some subunits stood out, and it was decided to initiate the implementation process in a group of platforms that was set up at CPqAM, and thus, the GLP Pilot Project was developed. In this center, there are three technological platform subunits (DNA sequencing, real-time PCR, and confocal microscopy) that are located in the same physical space and are administrated by a sole professional. As mentioned earlier, these platforms became part of the TPN in 2008, but even before that functioned as a multiuser organization that was part of the NIT, created by CPqAM in 2005.

Organization and definition of GLP positions

The definition of GLP positions was meant to establish responsibilities and job descriptions for all the professionals involved with GLP studies. The positions defined in the GLP guideline are: test facility management, test site management, sponsor, study director, principal investigator, study personnel, and archivist [17]. To this end, an organizational structure was defined by aligning the existing responsibilities of platform personnel with the positions created by GLP implementation.

In those cases in which the number of available professionals was less than the number of GLP positions necessary for the implementation of GLP, some professionals were assigned more than one position. In doing this, great care was taken to avoid conflict of interests, or, in other words, avoiding the placement of a professional in two positions, which had distinct objectives and actuations in GLP (i.e., Study Director and Quality Manager).

Modeling and elaboration of pertinent documentation

One extremely important stage relating to the implementation of QMS is the one in which the documents that establish the routines and procedures of each service or analysis are created. Once the NIT-DICLA-035 guideline had been chosen, all the documents elaborated were done in accordance with the requirements set out in the GLP.

Before the creation of a document, some criteria had to be established, and they were deciding factors in the process. They included the following: deciding whether the creation of a document was really necessary; choosing an appropriate author; standardizing a document so it could serve as a model for the creation of others; sharing the document with other ones that are used directly or indirectly with it; paying close attention to regulatory aspects when they are compulsory; not rewriting manuals or parts of books in documents citing them as supplements; using the correct language and grammar for the target public that will use the document; and not exaggerating the processes following through with objectivity and clarity [21].

The standard operating procedures (SOP) thus created included, among others: GLP position descriptions; document control; internal training; internal inspection; study plan elaboration; final report elaboration; and filling out a master schedule. Additional SOPs for describing technical experimental procedures, equipment use and maintenance procedures, and procedures for solution preparation were also created. It should be emphasized that for all documents

approved, there were training programs administered to all professionals who would be utilizing the documents.

Structuring the quality assurance program

The first step in structuring quality assurance (QA) was to define which professionals would be dedicated to these activities. In addition to selecting a quality manager for the TPN, it was necessary to choose a professional from CPqAM to be the quality manager for the subunits of the platforms in question, and thus in this way, there was a QA manager for the subunits of platforms allocated to CPqAM and a QA manager for the TPN. This initiative facilitated great dynamism in the elaboration and execution of activities, especially considering the enormous geographic distance between the QA manager for TPN located in Rio de Janeiro, and the CPqAM platform subunits participating in the Pilot Program, located in Recife, Pernambuco. The professionals involved received specialized training and had already had previous experience in the implementation of QMS. Aside from this, they did not participate in carrying out studies on the platform subunits in question.

After defining QA professionals, the activities to be implemented were established. These activities included the following: (1) the creation of a documented QA program to ensure that all studies would be carried out in compliance with GLP; (2) the revision of all documents to comply with GLP; (3) monitoring the study plan to be sure it conformed with GLP principles; and (4) implementing and carrying out GLP inspections and others [22].

Structuring the TPN's technological park

One of the most critical aspects related to the implementation of QMS in laboratories is control of the use, maintenance, and calibration of equipment that is used in all the routines. This is dealt with specifically in the GLP principles' guideline documents that reinforce the importance that all equipment involved in GLP studies be periodically inspected, cleaned, and subjected to maintenance and calibration procedures.

To facilitate the creation of procedures required for compliance, a register for all equipment in the TPN was created. This register contains information such as: manufacturer model and serial number, maintenance contract data, as well as electrical, hydraulic, temperature, and pressure requirements for the installation of each type of equipment. Currently, there are 220 pieces of equipment on the GLP database including large machines as well as periferal equipment. The equipment register has helped enable reviews of maintenance contracts, calibration, and questions related to equipment specifications and acquisition.

With the purpose of achieving these objectives, a log book model was developed for existing equipment with entries indicating use, verification (daily, monthly, or for each use), calibration, and maintenance.

The requirements of GLP adopted by the platform subunits where the implementation was made guaranteed metrologic traceability to national and international standards, as the calibrations were carried out in laboratories from the Brazilian calibration network that are all accredited under the ISO17025 guideline.

Evaluation through internal inspections and improvement programs

The verification of QMS implementation and compliance can be achieved through inspections and/or auditing. During inspections, proper compliance to routines, accreditation of professionals, the information register, as well as other aspects are scrutinized and evaluated. There are three types of GLP inspection: (1) study inspections carried out to monitor a specific study, starting by identifying its critical stages; (2) installation inspections, where the activities carried out are not related to any specific research, but are conducted to monitor installations and general activities such as computer systems, training, calibration, and maintenance among others; and (3) process inspection, also not based on a specific study, generally conducted randomly to monitor procedures and processes of a repetitive nature that are not otherwise easily audited viably or efficiently. This applies to short-term studies, and the inspections should be done randomly [22].

To evaluate the initial implementation of GLP on the technological platforms chosen to begin the process an internal inspection of the platforms was carried out via a Pilot Project. As it was the first inspection, it was very important that it preconize stringent requirements for all the guideline. After that, an improvement program was elaborated to establish goals and timetables for corrective and preventative actions that enable compliance to the GLP guideline. This phase was important as it enabled the visualization of all the difficulties encountered during the initial implementation phase, thus stimulating the creation of implementation strategies more in line with the realities existing on the platforms in question.

Starting with these activities, the annual internal inspections were defined to ensure compliance with the GLP guideline and establish further corrective and preventative procedures that foster the continuous improvement of all GLP activities.

The general policy for carrying out internal inspections was arrived at through a team of platform network inspectors. The inspections were carried out on the subunits that took part in the Pilot Project and were made by the

quality manager of the TPN and by the quality manager of the platform subunits in question. Neither of the professionals who inspected the platforms was involved with the GLP studies carried out on the platforms.

Final considerations

The concept and the infrastructure of TPN involve the providing of services in an environment that mainly caters to research and technological development activities. One of the greatest difficulties in implementing quality systems in scientific environments is related to the stages of standardization and the control of routines. Many times standardization is looked upon as an impediment to processes that are going to be present in the objectives and aims of research. Thus, as observed in GLP, no guideline related to the implementation of quality systems determines how documents, stages, routines, and professionals should be or act, but what should be done. It must be emphasized that the way something should be done is the strategic topic. Following this line, innovative processes, and those that look for quality without changing or slowing down stages, can translate into promising results. Reinforcing this possibility, recent data confirm that to achieve successful implementation of QMS in activities that involve R&D, there still must be a formal scope of accreditation and certification employed as it is indispensable for working in a culture of flexibility and originality, thus fostering and stimulating the innovation that moves scientific development [23].

Other difficulties observed are related to the higher volume of documents generated and their application. The creation of additional documents demands greater dedication of time and effort on the part of all the professionals involved, and for this reason, a new work system must be incorporated for all of them. This systematically presupposes that all activities are to be carried out in accordance with what is set out in the documents and that all the registers must be properly filled out, thus increasing bureaucracy [24].

On the other hand, it has become more and more evident that there are great benefits to be gained from the implementation of QMS in research environments. At present, the publication of a study that was carried out at a site that has some sort of QMS accreditation has become so frequent; it seems likely that soon this accreditation may become a requirement for publication in the most important scientific journals [25, 26]. Aside from this, advantages such as client satisfaction, credibility, continuous laboratory improvement by virtue of auditing processes and corrective actions, better equipment maintenance, and enhanced professional accreditation are evident in a system where QM has been established.

The implementation of GLP in the platform subunits mentioned above shows how the proper interpretation and understanding of the published guideline can make a difference in the effectiveness of a defined system. In GLP, the test installation manager has formal authority and responsibility for organizing and running the operating unit, while the study director is the person responsible for designing and carrying out research. In the case of the platform subunits that were objects of study in this work, the role of a test installation manager was given to the technologist responsible for the nucleus, while the role of study director was given to the technician responsible for carrying out analyses on each platform, factors which in a certain way have facilitated the organization and filing of the relevant documents for each study, such as the study plan and the final report. Another important topic for GLP implementation on these platform subunits was related to the choice of the application of short-term studies. The GLP guideline preconizes the use of these studies in cases where the technicians are used to, and capable of, supplying easily repeated results, frequently expressed using simple numerical values or verbal expressions. In practice, this routine has been adopted since the techniques, and experimental procedures are very similar for each platform, and the use of a common study model foster practicality as well as reducing bureaucratic red tape at some stages of the process. The implementation of GLP has made possible, through the elaboration of a master schedule, the compilation of all analyses carried out on each platform, facilitating annual budget planning for the purchase of reagents, and maintenance in line with the demands of each platform. All in all, perhaps the most important contribution to the implementation of QMS was making CPqAM researchers and the platform users aware of the importance of establishing rules for the shared use of equipment. The experience obtained in implementing QMS on the GLP Pilot Project made viable the implementation of GLP in all the platform subunits in the TPN.

In general, there are some determining factors for the successful implementation of QMS in R&D environments, including: the acceptance and commitment of all professionals involved to the so-called “quality culture” [27], the development of a flexible documentation system, and, most importantly, the structuring of a self-sustaining QMS system that is capable of adding value to the institution [27, 28].

There is still much to be learned about the implementation of QMS in R&D environments, and there are more challenges to be met in this area. However, it has become more and more obvious that in the near future, there will be no alternative to the adoption of some kind of QMS, principally due to external pressures from regulatory agencies, companies, which contract services, and research

institutions. The implementation of Good Laboratory Practices (NIT-DICLA-035, Inmetro) appears to be a simple, flexible, and effective way to achieve these objectives.

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