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SCIENTIFIC ARTICLE

Information management in laboratory animal facilities for non-human primates: what we have been using in Brazil

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Abstract

In digital curation, data are essential for actions, enabling better administrative management and greater efficiency in a sector or activity. In a research animal facility, the collection of management data associated with management systems or control sheets is the basis for ensuring quality information that subsidizes research and generates performance indicators and the needs and challenges to be transposed in the breeding and maintenance of animals. The inconsistency of data or incomplete records compromises the choices adopted in husbandry management practices or the interpretation of research results. For this reason, a survey was carried out about software available on the market that helps laboratory animal facilities with the management regarding software used in non-human primate breeding institutions (NHP) for scientific or conservation purposes. We identified 38 software that supports the handling of lab animals used in biomedical research; most of them with functionalities of environmental control (63.15%), control of animal files/tags (63.15%), and control of reproductive management (60%) and only two software related to the management of non-human primates kept under human care in research institutions. Regarding the tools used to manage the breeding of non-human primates in captivity in Brazilian institutions, five of the institutions questioned and reported that none currently uses software for colony management. In conclusion, there are several software for managing laboratory animals, but most of them are geared towards the management of rodent animal facilities. There is a lack of specific software on the market for use in animal facilities managing non-human primate breeding, which indicates the need for software developed to meet the management needs of animal facilities for these facilities.

Keywords: laboratory animals, non-human primates, software, data management, laboratory animal science.

INTRODUCTION

Information and Communication Technologies have become increasingly inserted into the routine of society, with a growing appreciation of data, recognized as precious inputs for research, institutions, and organizations. Information is generated from the interpretation of data in a context, and the understanding of this information creates knowledge, adding value to the research or the institution[1]. The value of information is a function of the organization's context, how and for what it is used, the decision-making process, and the results of these decisions[2]. In this context, the field

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of information management is considered a structured set of activities that encompass the way companies capture, distribute, and use the information and knowledge generated[3].

In all scientific environments, data management is central. The results of the studies depend on the handling of data, from its entry into the life cycle of research to the dissemination and archiving of the results, to guarantee their verification[4]. According to Kaplan[5], what cannot be measured cannot be managed either. When information is tabulated, refined, and correlated, it generates knowledge responsible for an organization[5]. Therefore, good practices of collection, storage, and traceability of information are necessary since condensing them without pre-defined objectives will only cause an accumulation of paper and spreadsheets without purpose[6].

The maintenance of animals in breeding facilities is an activity that requires systematic and continuous observation, seeking to measure the determining problems in the health of the animals, recording and transmitting the data of these observations to a database[7]. The comparison and interpretation of data are essential to detect possible changes in the group's health status and management.

Thus, data collection should include the analysis, interpretation, and feedback of the information generated in a systematic way[7]. The collection of inspection and animal handling data and the transfer to management systems or control sheets are the basis for guaranteeing quality information that will provide subsidies for research and help identify the needs and breeding's off-sides. Inconsistencies in data or incomplete records compromise the choices adopted in management practices or the interpretation of scientific investigation[8]. For this reason, the electronic archiving of data begins to be actively stimulated by funding agencies, which increasingly require that projects include the submission of generated data to repositories that can be trusted[9].

When efficient management occurs, the result can also be seen in the potential of the animal facility to become financially sustainable and with a better view of the applicability of financial resources[10].

To facilitate both the management and the interpretation of the information collected within a herd, the use of specific software for the management of animal facilities has become a valuable option for the deposition, maintenance, and recovery of data from the different routines, making possible a more dynamic control of all the zootechnical activities, allowing all the information generated by researchers and administrators to be carried out in real-time, maintaining the traceability and reliability of the process, in addition to the reduction of operational activities[10].

Among the scientific breeding animals, the breeding and maintenance of non-human primates for use in biomedical research requires the improvement of the management of the information generated given the complex management, which involves the administration of groups of animals according to social interactions and other particularities. Motivated by obtaining knowledge about the tools that help control laboratory animal facilities, the survey about the software available on the market for this purpose, particularly the software to manage the information generated in the PNH laboratory animal facilities in Brazil and other countries.

METHODOLOGY

The collection of information about software and other tools that help the management of laboratory animal facilities for use in research took place in two stages:

Search for registered software in databases

A search was carried out for software available on the market that helps in the management of data generated in animal facilities around the world from the following databases: INPI (Brazil)[11], a product database for laboratory animal facilities on the LabAnimal website (periodical scientific - specific products and suppliers guide for animal facilities/UK)[12], AALAS (American Association

for Laboratory Animal Science - purchasing guide for scientists/USA)[13], United States Patent and Trademark Office[14] database and Google Patents[15]. In the INPI software search database, the following search terms were used, alone or in combination: "animal facility"; "animal"; "husbandry"; "management"; "laboratory animals"; and "non-human primates". In the Animal Lab and AAALAS databases, the terms "management software" and "software solutions" were used. In the United States Patent and Trademark Office database the terms used were: "laboratory animals" and "animal facility", alone and in combination, with the terms "husbandry" and "management" and the combined terms "primates and software". In Google Patents, the search term used was "software for laboratory animal facilities. After the selection of software with specialized application to laboratory animals, an analysis was carried out about the functionalities provided by the software that help the management of animal facilities, such as environment control, file control, recording of study protocols, control of reproductive management, control of sanitary management, genetic control, control of experimentation, integration with the IACUCs, financial management, team management, and equipment supervision.

Survey on the management of management data in PNH breeding facilities

From February to April 2022, a search for institutes that use PNH for scientific purposes throughout the Brazilian territory was conducted in the Registration of Institutions for the Scientific Use of Animals (CIUCA), where 15 institutions were cataloged that operate among the activities of maintenance, production and use of PNH. On the list there was no mention of the institutions' contacts. After searching for contacts of the researchers working in these institutions, 7 email contacts were found and subjective questions were sent about the form of data collection in their research, forms of data extraction, use of software, and generation of indicators. The consultation was also carried out among the scientific community that uses PNH as biomodels established in other countries, and that is part of the Primate InfoNet[16] mailing list, a directory of the Wisconsin National Primate Research Center and which brings together people currently active in many areas of research, education, and conservation of primates, including researchers, technicians, primatologists, veterinarians and the corresponding regions on the needs inherent in the collection of breeding data.

RESULTS

We found 38 software available on the market for laboratory animal facility management listed (two of them developed in Brazil and 36 of them in other countries) (Table 1). Two software were found with features related to the management of non-human primates kept under human care in research institutions.

More than half of the software was found to have the following functionalities: environmental control (n=23), individual animal files/tags (n=22), and control of reproductive management (n=21). Sixteen of these have integration with the IACUCs database (42%), only one of them has the equipment supervision functionality, three of them help genetic control and team management, and four help control the experimentation (Figure 1).

Regarding the tools used to manage the breeding of non-human primates in animal facilities, 5 of 7 Brazilian institutions answered, but none of them reported the use of software for colony management. All perform the records manually in individual cards and log books. However, two of them said that they are developing specific software using Information Technology sectors of the institution, with features that meet the peculiar needs of the management established in the institution (Table 2).

Table 1. Software for laboratory animal facility management and functionalities

Software	Environment control	Control of animal cards/tags	Recording of study protocols	Reproductive management control	Sanitary management control	Genetic Data control	Experimentation control	Link with iacuc	Financial management	Team management	Equipment supervision	Websites
BehaviSoft	-	-	-	-	-	-	-	-	-	-	-	-
Expt-o	-	-	-	-	-	-	-	-	-	-	-	-
Animal Lab Care	-	-	-	-	-	-	-	-	-	-	-	-
Controle de ambiente	-	-	-	-	-	-	-	-	-	-	-	-
Bioterc	Ok	Ok	-	Ok	-	-	-	Ok	-	-	-	https://bioterc.com.br/
tick @ lab	Ok	Ok	Ok	Ok	-	-	-	-	-	-	-	https://www.a-tune.com/products-services-software/animal-research-facility-software/
LabCollector	Ok	Ok	-	-	-	-	-	-	Ok	-	-	https://labcollector.com/
LARS	-	Ok	-	Ok	Ok	-	-	-	Ok	-	-	https://www.keyusa.com/landing-page-lars.html
Programa ENOS	Ok	Ok	-	Ok	-	Ok	-	-	-	-	-	https://poweredbyenos.com/
Armis	Ok	Ok	Ok	Ok	Ok	-	-	Ok	-	-	-	-
Animal Bioware	Ok	Ok	-	Ok	-	-	-	Ok	-	Ok	-	https://www.animalbioware.com/
Avidity	Ok	Ok	-	Ok	-	-	-	-	-	-	-	https://www.aviditybiosciences.com/
Ponemah	-	-	-	-	Ok	-	-	-	-	-	-	https://www.datasci.com/products/software/ponemah
Cayuse	Ok	Ok	-	Ok	-	-	-	-	-	Ok	-	https://cayuse.com/
RPM	Ok	Ok	Ok	Ok	-	-	-	Ok	Ok	-	-	-
Pris	Ok	Ok	Ok	Ok	Ok	-	-	Ok	-	-	-	-
Galilei	-	-	-	-	-	-	-		-	-	-	https://www.galileisoftware.com/
Geneoz	Ok	Ok	-	Ok	-	-	-	Ok	-	-	-	https://www.geneoz.com/
Instem	Ok	Ok	Ok	Ok	-	-	-	Ok	-	-	-	https://www.instem.com/
Keyusa	-	-	Ok	-	-	-	-	Ok	-	-	-	https://www.keyusa.com/products.html
Locus	Ok	Ok	-	Ok	-	-	-	Ok	Ok	-	-	-
MayaKind	Ok	Ok	-	Ok	Ok	-	Ok	Ok	-	-	-	http://www.mayakind.com/
NorayBio	Ok	Ok	-	Ok	Ok	-	-	Ok	-	-	-	https://www.noraybio.com/index.php/pt/

* features related to the management of non-human primates kept in captivity

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Table 1. Continued...

Software	Environment control	Control of animal cards/tags	Recording of study protocols	Reproductive management control	Sanitary management control	Genetic Data control	Experimentation control	Link with iacuc	Financial management	Team management	Equipment supervision	Websites
Osgenic	-	-	-	-	-	-	-	-	-	-	-	https://www.osgenic.com/
Sionics (PyRAT)	Ok	Ok	-	Ok	-	-	Ok	Ok	Ok	-	-	https://www.scionics.com/pyrat.html
StudyLog	-	-	-	-	-	-	Ok	-	-	-	-	https://www.studylog.com/
Swiftag systems	-	-	-	-	-	-	-	-	-	-	-	https://www.swiftagsystems.com/
Realview	-	-	-	-	-	-	-	-	-	-	Ok	https://realviewimaging.com/
Vium	Ok	-	Ok	-	-	-	Ok	-	-	-	-	https://www.vium.com/
armsd	Ok	Ok	-	Ok	Ok	-	-	Ok	-	-	-	- I
EZ System sinc	-	-	-	-	-	-	-	-	-	-	-	-
Turner scientific	Ok	-	-	-	-	-	-	-	-	-	-	https://www.turnerscientific.com/
Mosaic vivarium	Ok	Ok	Ok	Ok	-	-	-	Ok	-	-	-	https://mosaicvivarium.net/
Infoedglobal	Ok	Ok	Ok	Ok	-	-	-	Ok	-	-	-	https://www.infoedglobal.com/
Climb-A	Ok	Ok	Ok	Ok	Ok	-	-	-	-	-	-	- I
Omikron (LAVAN)	Ok	Ok	Ok	Ok	Ok	-	-	Ok	-	-	-	https://www.omikronsystems.com/
ZIMS*	-	Ok	-	Ok	Ok	Ok	-	-	Ok	Ok	-	https://zims.species360.org/Login.aspx?ReturnUrl=%2f
ARGOS*	Ok	Ok	Ok	Ok	Ok	Ok	-	-	-	-	-	https://argos.eco.br/

* features related to the management of non-human primates kept in captivity

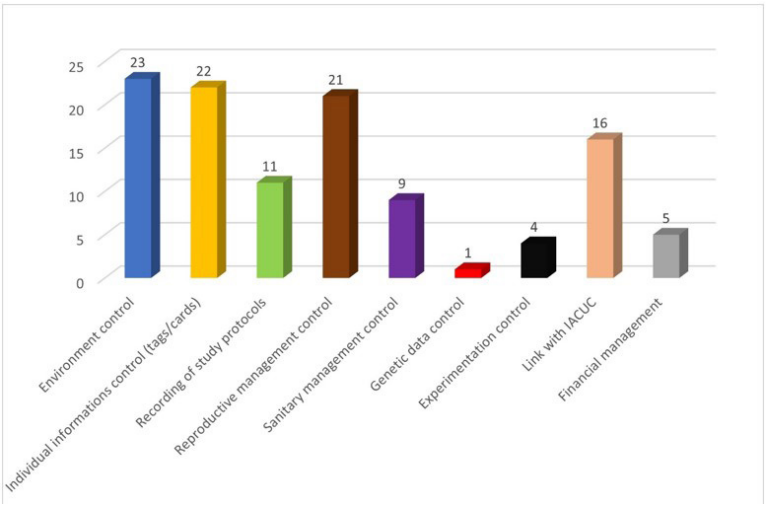

Figure 1. Functionalities in laboratory animal management software on the market and number of software presenting each functionality

Table 2. Information provided by Brazilian institutions (n=5) that maintain non-human primates for scientific purposes on colony data records

Institution	Use of data management software	Production of indicators	Data storage
A	**No**	**No**	Log books
B	**No**	**No**	Log books
C	**No** (under development)	**Yes**	Individual cards
D	**No** (under development)	**No answer**	Individual cards; Excel
E	**No**	**No**	Individual cards; Log books; Excel

DISCUSSION

Although the need to modernize data management is a consensus among scientists and professionals working in animal facilities, the consultation of animal facilities for Brazilian non-human primates showed that, at present, none of them uses software for animal facility management.

The research highlighted that most Brazilian PNH breeders keep their records exclusively in handwritten form, which, many times, may contain inaccurate and duplicated data in several repositories (cards, Excel spreadsheets, etc.), the which makes it difficult to trace the data and, therefore, jeopardizes the monitoring and improvement of the procedures adopted in the breeding and handling of animals. It is worth emphasizing that the interface of these repositories, in most cases, is not intuitive, does not facilitate the grouping and crossing of data from different sources, compromises the standardization of information filling, and results in an individualistic interpretation of the data, in addition to not providing other functionalities. that enable better information management[10]. Therefore, technology makes it possible to devise instruments for collection, registration and control that are appropriate to professional demands and specificities. The computerized storage of medical records and the entire clinical record of the animal is a safe way to standardize the data and make them accessible to the entire team in order to improve the activities performed[17].

According to CIUCA[18], there are 710 research institutions in Brazil. However, only 15 of them work directly with NHP, which is less than 2% in total. Thus, the available software on the market are mostly directed to rodent and lagomorph facilities, since the number of animal facilities that work with these species is significantly higher.

In Brazil, all scientific non-human primate facilities for scientific purposes are maintained by public universities and research institutions, which have challenges that most Brazilian public institutions face in modernizing data management, such as a lack of IT infrastructure satisfactory to the users associated with the need for training them to use the tools, lack of technical support, lack of motivational policies and cultural resistance to change, among other factors[19].

In addition to these factors, the Brazilian government establishes guidelines for the management of public data that prioritize the use of free software in sectors of the federal public administration to maintain information security, in addition to having legislation related to the acquisition of inputs, a category where Paid software is framed, which requires periodic bidding in the search for suppliers that can offer the lowest price, making the continuous acquisition of the same product for many years unfeasible, as an analysis of the software life cycle and its total costs must be carried out property that includes other factors such as usability, expert application, and most suitable solution[20].

There are still other factors that make it challenging to acquire paid software in the Brazilian public sector: changing requirements, the delay in contracting within the public administration causes the conditions found at the beginning of the process to change; the lack of knowledge of the integration of work processes, as many organizations bid for software with an understanding knowledge of their work processes and the correlations between them[21] and the security of possession of the data, since it is necessary to consider the framework from software to software usage policy, as well as institutional guidelines, strategies and policies[22].

Keeping a diligent record of the activities carried out in a laboratory animal facility, combined with an effective information management process, can assist in the collection of relevant data in the literature on primate health, in addition to enabling a better understanding of biological parameters in the species under study and more precise knowledge of the degree of similarity between experimental biology and the facts of human life, with some of the evaluated data being scarcely reported in the literature that often share the results, but fail to mention the data that develop such results[18].

When dealing with the management of animals on a research farm, it is essential to use technological tools that can help improve the management of animals used in research[23] since the proper treatment of data allows decision-making and the elaboration of projects and preventive programs based on the highest number of visits or causes of occurrences, in addition to helping to manage the costs inherent to animal experimentation[24].

It´s very important that a software for the management of PNH kept in institutions for research purposes must include information that goes beyond reproductive management, such as clinical care, IACUC protocol to which this animal will be intended, among others that allow scientific reproducibility.

CONCLUSION

There is a considerable offer of software to aid the management in laboratory animal facilities applied to lab rodents. However, specific software for use in animal facilities dedicated to breeding non-human primates is not available for purchase.

Logbooks are still the primary way of compiling data from non-human primates' colonies kept in laboratory animal facilities in Brazil, signaling that the country needs to invest in software development that allows better management of information from resulting-human primates in a better quality of the research carried out with them.

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