Prospection for metrological control in medical scales and sphygmomanometers in the state of Santa Catarina – Brazil

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Abstract. This study presents a method to identify the universe of establishments in the health area where the use of measuring instruments subject to metrological control and periodic verification are mandatory. Through research of external databases and complemented with field visits, it was possible to estimate the number of scales and clinical sphygmomanometers that are currently in use by these establishments in the state of Santa Catarina. The results are useful for developing strategies in order to prospect, plan and execute the mandatory metrological verification of instruments in the health area in Santa Catarina.

1. Introduction
In the health area, the National Institute of Metrology, Quality and Technology - INMETRO develops regulations and delegates powers to a network of competent state institutes to carry out field activities such as mandatory verification of measuring instruments [1,2]. Among these instruments we highlight the clinical scales for weighing adults, pediatric scales and sphygmomanometers, also known as blood pressure cuffs.

The lack of metrological control or verification as well as the inadequate frequency of verification of these instruments causes several measurement errors, leading to misdiagnosis and even improper application of medication or procedures that endanger the health and lives of people.

Several studies demonstrate the need to invest efforts in metrological control, and we draw special attention to the sphygmomanometers [3-7].

It is also important to stress the lack of awareness and initiative of almost all professional or holders of these instruments, which do not look for INMETRO or one of their delegates institutes in the country to carry out the mandatory verification of their instruments.

Therefore, the Metrology Institute of Santa Catarina - Imetro/SC, the delegated Institute of INMETRO in the state of Santa Catarina, started visiting health establishments in order to verify the compliance of the above mentioned measuring instruments.

However, this initiative has brought great challenges, starting with the need to find out and estimate the quantitative of measuring instruments subject to verification.

This study aims to identify the potential demand for the mandatory verification of clinical scales and sphygmomanometers in the state of Santa Catarina and proposes ways to cope with the demand.
2. Method for the prospection of instruments in the health area
The study to identify the potential demand for the mandatory verification of clinical scales and sphygmomanometers in the state of Santa Catarina has been divided in two steps:

- Step 1 – Estimate the universe of health establishments in the state of Santa Catarina.
- Step 2 – Estimate the number of clinical scales and sphygmomanometers in the identified establishments.

Data collection was conducted through visits to health establishments which addresses were obtained from the National Register of Health Establishments (CNES) of the Ministry of Health in Brazil, and from the database of the Annual Social Information (RAIS) of the Ministry of Labour and Employment in Brazil (MTE).

The CNES information is constantly updated and is available in the Internet [8].

On the other hand, information from RAIS used in this research was picked up from the 2011 database. RAIS is now available to INMETRO as a result from a memo of understanding celebrated by INMETRO and MTE.

Research from RAIS was done using the Monitoring System of Coverage - SIMCS, developed by INMETRO/Cored [9,10].

2.1. Step 1 - Estimate the universe of health establishments in the state of Santa Catarina.
For the purpose of legal metrological control, the following are considered health area establishments: hospitals, clinics, doctors' offices, health clinics, pharmacies, including manipulation ones, fitness gyms (bodybuilding, swimming ...).

The survey began with research from CNES, which showed that there are 11,457 health establishments that actually operated in Santa Catarina in 2012. It includes hospitals, clinics, doctors' offices and public health posts.

Estimate of pharmacies, including manipulation ones and fitness gyms, was obtained from SCE (updated with information from RAIS 2011) that showed the existence of 3,417 pharmacies, 412 manipulation pharmacies and 983 fitness gyms in Santa Catarina.

Therefore, as per figure table 1, the conclusion of this initial estimation was that there are approximately 16,269 health establishments with scales and/or sphygmomanometers subject to mandatory metrological verification.

| Hospitals, clinics, doctors' offices, public health posts (CNES 2012) | Pharmacies, fitness gyms (RAIS 2011) | Total |
|-------------------------------------------------|-----------------------------------|-------|
| 11,457                                          | 4,812                             | 16,269|

2.2. Step 2 - Estimate the number of clinical scales and sphygmomanometers in the identified establishments
During 2012 and early 2013, visits were carried out in the health area establishments chosen from a sample of eight randomly selected municipalities of Santa Catarina: Tubarão, Criciúma, Araranguá, Içara, Morro da Fumaça, Imbituba, Braço do Norte e Orleans.

For each of these municipalities were generated lists of health area establishments (with its addresses) extracted from the database of CNES and RAIS. The number of establishments visited by municipality was defined considering to how long each field agent stays in each municipality during their regular visits to other establishments. In other words, the filed agents were invited to visit some additional establishments (the health area ones) during their regular visits to the mentioned municipalities.
In total, 813 visits in hospitals, clinics, doctor's offices, nursing activities, physiotherapy, health centers, pharmacies and gyms were visited.

From this total, scales and sphygmomanometers were found in 516 establishments. In the majority of them there were no check verification tag or its validity was expired.

Table 2 presents the percentages of correct CNES and RAIS in terms of establishments which were actually operating and with scales and/or sphygmomanometers in use.

| Database   | Number of establishments that were visited | Number of establishments were instruments were found |
|------------|-------------------------------------------|-----------------------------------------------------|
| CNES 2012  | 446                                       | 311 (69.7 %)                                        |
| RAIS 2011  | 367                                       | 205 (55.9 %)                                        |
| TOTAL      | 813                                       | 516 (63.5 %)                                        |

The percentage of correct information from CNES was 69.7%. In this database, 9.9% of establishments were closed or with address errors and 20.4% of establishments had no scales or sphygmomanometers in use.

The percentage of correct information from RAIS was 55.9%. In this database, 40.6% of establishments closed or with address errors and 4.4% of establishments had no scales or sphygmomanometers in use.

Table 3 shows the number of clinical scales (adult and pediatric) and sphygmomanometers found and the amount of these instruments per type of establishment.

| Type of establishments | Hospitals, clinics, doctors' offices, public health posts (CNES 2012) | Pharmacies, fitness gyms (RAIS 2011) | Total |
|------------------------|---------------------------------------------------------------------|-------------------------------------|-------|
| Number of establishments were instruments were found | 311 | 205 | 516 |
| Number of Clinical Scales | 544 | 213 | 757 |
| Scales per establishment | 1.75 | 1.04 | 1.47 |
| Number of sphygmomanometers | 1,000 | 164 | 1,164 |
| Sphygmomanometers per establishment | 3.20 | 0.80 | 2.26 |

From the sample of 516 existing establishments, 1,164 sphygmomanometers were found and 757 clinical scales were found, representing on average, 2.26 sphygmomanometers and 1.47 scales per actually operating establishment.

Such trend is assumed to be similar in the other municipalities and allows a projection of the number of clinical scales and sphygmomanometers in use throughout the state of Santa Catarina, as shown in Table 4.

To calculate the numbers of measurement instruments were considered 69.7% of establishments from CNES and 55.9% of establishments from RAIS, as these were the percentages of establishments found that were actually operating and with measuring instruments in use.

The research identified an estimated universe of 10,666 establishments in the health area in Santa Catarina, with approximately 16,763 clinical scales and 27,699 sphygmomanometers in use and therefore subject to legal metrological control of Imetro/SC.
Table 4. Estimation of clinical scales and Sphygmanometers currently in use in Santa Catarina.

| Type of establishments                                      | Establishments with scales and/or sphygmo. | Estimation of clinical scales | Estimation of sphygmanometers |
|-------------------------------------------------------------|------------------------------------------|------------------------------|-------------------------------|
| Hospitals, clinics, doctors' offices, public health posts   | 7,986 (69,7% do CNES)                    | 13,976                       | 25,555                        |
| (CNES 2012)                                                |                                          |                              |                               |
| Pharmacies, fitness gyms                                   | 2,680 (55,7% da RAIS)                    | 2,787                        | 2,144                         |
| (RAIS 2011)                                                |                                          |                              |                               |
| Total                                                       | 10,666                                   | 16,763                       | 27,699                        |

It is important to mention the significant number of establishments that were closed or with address errors as well the report from our field agents that confirms the lack of awareness of the health professional as far as the legislation and benefits of verification of the instruments are concerned. More than forty medical offices visited did not allow the access of the fiscal agent, claiming not to have scales or sphygmanometer. Such information seems no to be true. Countermeasures for such facts need to be developed.

3. Results of the research

The results are useful for developing strategies in order to prospect, plan and execute the mandatory metrological verification of instruments in the health area in Santa Catarina.

The number of establishments and instruments that were identified as a consequence of this study can be used to foresee the equipment required to meet the existing demand for each municipality.

The prior identification of the addresses, through external databases CNES and RAIS, represents a major breakthrough against the usual practice of the fields agents. It is now possible to look for new establishments with appropriate tools.

This previous knowledge of addresses to be visited enables logistics decisions that prioritize efficiency.

4. Conclusions

The identification of the universe and the location establishments in the health area, and the estimated number of scales and sphygmanometers in use, enable us to:

- Define the required number of fiscal agents;
- Improve logistics operations;
- Establish planning with realistic goals;
- Estimate the costs of implementing of mandatory verification in this the health area.

It is also important to stress that the methodology of research can be applied in any other state in the country. The states that have got the same level of Santa Catarina in the health area will probably have the same results once the number of scales and sphygmanometers in health establishment will probably be similar.

The experience of looking for information in the external environment and the development of innovative tools such as the Monitoring System of Coverage - SIMCS developed by INMETRO/Cored, are important initiatives to improve the planning and execution of the legal metrological verification in the country.

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