Informatics as Support for Changes in Health Policy: A Case in Obstetrics

Giovana Jaskulski Gelatti[1,2][a], Pedro Pereira Rodrigues[2,3][b] and Ricardo João Cruz Correia[2,3][c]
[1]*Institute of Mathematical and Computer Sciences of University of São Paulo, 13566-590, São Carlos, Brazil*
[2]*Centre for Health Technology and Services Research, 4200-450, Porto, Portugal*
[3]*Universidade do Porto, Faculty of Medicine of University of Porto, 4200-319, Porto, Portugal*

Keywords: Health Policies, Medical Information, Health Data Science, Computer Support, Robson Classification, Obstetrics.

Abstract: **Introduction:** In 2015 the Directorate-General for Health of Portugal published new standards (DGS 001/2015) for the registration of cesarean section indicators. The existing scenario was the lack of data, influencing the quality of indicators and analyses on them. The use of a single computer tool was encouraged to register and compare indicators between hospitals with special attention to the Robson Classification as it employs basic information of pregnancy to classify all deliveries in 10 groups. The selected tool was Obscare software.
Aim: Describe the scenario on data quality by analyzing the completeness of obstetric records from 2016 to 2018 of the variables used in Robson's classification collected by the Obscare tool.
Methods: The completeness is evaluated using a number of missing values. The lower the completeness, the higher the number of missing values. Also, we perform the imputation of data based on basic concepts and analyzed the participation of this data in the indication of the type of delivery to be performed according to classification suggested by DGS 001/2015.
Results: From 2016 to 2018, 5922 number of pregnancies resulted in 5922 of Robson Classifications. The variables with lower completeness were related to previous cesarean section (77%) and previous pregnancies (43%). After imputation, it fell to 3.9% and 0.56%, respectively causing 4.6% of discarded data from the total.
Discussion: There is a significant amount of missing data in basic variables used to study the classification of delivery type. We believe that encouraging data completion with the possibility of comparing data between hospitals should be a priority in the health area.

1 INTRODUCTION

Cesarean section is a surgery that provides a high risk of complications to both the pregnant woman and the baby, its rate is used as one of the health indicators. However, the current scenario reveals high rates of this type of delivery (Betrán et al., 2016) and the decrease in cesarean rate has become a governmental concern. To reverse this framework, changes in health policies have been designed.

In Portugal, the Directorate-General for Health (DGS, Portuguese acronym) published Standard No. 001/2015 which defines concepts of cesarean section, reasons for its performance and classifications of cesarean types regarding the urgency of surgery, absence or labour phase of delivery, main reason of indication to surgery and main characteristics of pregnancy, indicating the Classification of Robson (Robson, 2001) for the latter. By implementing national health policy in northern Portugal, the Regional Health Administration of the North I.P. (ARSN), responsible for propose the committee for the reduction of the rate of cesarean sections (CRTC). This committee, when evaluating the frequency and reasons for cesarean sections, was faced with the lack of standardized computerization of maternal-fetal data, which makes it difficult to understand the current situation. As a result, one of the first measures of the CRTC was to propose "the implementation of a single computer program for hospital registration of perina-

[a] https://orcid.org/0000-0003-1003-7010
[b] https://orcid.org/0000-0001-7867-6682
[c] https://orcid.org/0000-0002-3764-5158

Gelatti, G., Rodrigues, P. and Correia, R.
Informatics as Support for Changes in Health Policy: A Case in Obstetrics.
DOI: 10.5220/0009173807450749
In *Proceedings of the 13th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2020) - Volume 5: HEALTHINF*, pages 745-749
ISBN: 978-989-758-398-8; ISSN: 2184-4305

tal data (...) to allow the automatic export of perinatal indicators to ARSN" and "annual public disclosure by the ARNS of the cesarean rate of each hospital center"(Campos et al., 2010), thus contributing to the improvement of indicators.

One system used in hospitals in Portugal that meets all DGS and ARSN requirements and chosen by the Northern Region Operational Programme for this purpose is Obscare. Obscare is used in 15 hospitals in Portugal and through Obscare, the reports composed of obstetric indices and all required in the DGS Standard are generated.

This article aims to describe the current scenario on data quality after changes required by DGS and ARSN. Besides, some findings and discussions are reported.

1.1 Implementation of the Policies Required by DGS

In 2015, the carelessness was reported with health data and, for this reason, hospitals are required to follow Standard No. 001/2015. The standard requires hospitals to deliver to DGS a detailed annual report with the definitions described in its standard. One of the definitions is to include Robson Classification on these reports.

The Robson Ten Group classification (RTGC) has four criteria and, from them, all pregnant women can be classified into 10 mutually exclusive and fully inclusive groups. The criteria are on obstetric history (nulliparous or multiparous with or without anterior cesarean section), the type of pregnancy (single cephalic or pelvic or transverse fetus, multiple pregnancy), how childbirth is triggered (spontaneous, induced or cesarean section and the gestational age at which childbirth occurs (before or from the 37th week). Based on these criteria, pregnant women are classified into one of the groups described in Table 1. The criteria are of simple identification and classification, clinically relevant. And so, obstetric centres from around the world begin to use this classification.

Table 1: Characteristics of each group of Robson's classification.

Group 1	Nulliparous, singleton, cephalic, $\geq$37 weeks' gestation, in spontaneous labour
Group 2	Nulliparous, singleton, cephalic, $\geq$37 weeks' gestation, induced labour or caesarean section before labour
Group 3	Multiparous (excluding previous caesarean section), singleton, cephalic, $\geq$37 weeks' gestation, in spontaneous labour
Group 4	Multiparous without a previous uterine scar, with singleton, cephalic pregnancy, $\geq$37 weeks' gestation, induced or caesarean section before labour
Group 5	Previous caesarean section, singleton, cephalic, $\geq$37 weeks' gestation
Group 6	All nulliparous with a single breech pregnancy
Group 7	All multiparous with a single breech (including previous caesarean section)
Group 8	All multiple pregnancies (including previous caesarean section)
Group 9	All women with a single pregnancy in transverse or oblique lie (including those with previous caesarean section)
Group 10	All singleton, cephalic, $<$37 weeks' gestation pregnancies (including previous caesarean section)

1.2 Obscare

Obscare (see http://virtualcare.pt/portfolio/vc-obscare/) is an electronic clinical obstetrics and gynaecology registration system designed to be used by doctors, anesthesiologists, nurses and administrative staff. The system is installed in 15 hospitals in Portugal, 37% of Portugal's public hospitals (data provided by Virtualcare enterprise, owner of Obscare), and has a proper semi-structured form with support for user input per clinical event. Each event has forms defined with experts in the field that meet all requirements defined in DGS standards. It is also possible to export monthly, quarterly, half-yearly and annual reports used to compare the indicators and data quality in these periods. In addition to the presence in several hospitals in Portugal, there was a growing use of the system and records for scientific production in the country (Pereira et al., 2019). This growing demand for the use of its data has generated concern about the quality of what is being shared. Obscare discloses in its reports the information on the quality of data in the period examined. Informing the quality of data to hospitals encourages the search for an increasing data fill. Although it is a robust and complete system that allows the registration and analysis of data for hospitals, the quality of health research is related to this quality in filling out data by users.

2 METHODS

Despite the concern stemming from data computerization and implementation of new policies, many retrospective data are uncertain. When deploying the

new rules, cases of empty of basic data for classification or any use of the data were reported. (Vogel et al., 2015) says that "the population level CS rate is too crude to be useful as clinical indications for CS data are missing" and this causes a great risk to the academic community that relies on the data for reproduction and development of new knowledge from them.

From 2015 to the current year, hospitals paid greater attention to the misconceptions of filling and validating their data to fit DGS standards. Hospitals were required to adopt the rules for building DGS reports, including Robson's classification and interpreting the classification for an improvement in their data and reporting cesarean rates in their hospitals.Despite the new rules, there are missing data in the variables used for RTGC (Begum et al., 2019; Linard et al., 2019; Senanayake et al., 2019; Ming et al., 2019; Zimmo et al., 2018; Kacerauskiene et al., 2018) and limitations in the application of the same (Betrán et al., 2014; Rebelo et al., 2010). As small as the limitations for applying classification or missing data are, the variables used are basic for obstetric data analysis.

To develop the analysis on the quality of health data in recent years, data on obstetrics, specifically the variables used for Robson's classification of a hospital using the Obscare system, were used. An analysis of data completeness and deterministic imputation was performed in missing data.

2.1 Case of Study

The data collected by the Obscare system of a Portuguese hospital refer to the variables used for Robson's classification in 2016, 2017 and 2018. At first instance, a large number of missing data was found. However, it was possible to perform a deterministic imputation through the concepts present in non-empty variables, for example, as per Robson's associated group. With most of the records identified by these groups, it was possible to fill values on the characteristics associated with the group, performing a deterministic imputation.

Another definition was the variable of the number of deliveries prior to pregnancy. Observations classified as group 1, 2 or 6 are nulliparous, without previous deliveries, so the verification and/or imputation of value 0 was applied in the delivery variable already made. It also serves in the case of the variable regarding the number of pregnancies, including current: if 1 is the first pregnancy and there are no pregnancy or background deliveries, the amount of pregnancies and previous deliveries is 0.

The observations classified in group 1 and 2 of Robson's classification refer to nulliparous pregnant women and those in group 3 and 4 are multiparous but without antecedent cesarean sections. The variable referring to previous cesarean sections of the observations identified in these groups were filled with the zero value.

Information was also searched in structured or free text variables that could have relevant information from each observation with the unknown Robson group for it to be filled. In total, there were 39 observations without group identification. Using variables of cesarean section motif and diagnoses that contained obstetric antecedents, Robson's group of 4 observations were identified.

13 cases with gestation week values in -1 were analyzed on a case-by-case basis. 12 cases were classified in group 10 corresponding to pregnant women of a baby with cephalic presentation and preterm. The value was corrected for the average of weeks of gestation in group 10 (35 weeks). No relevant information was found for filling weeks of gestation from the remaining observation since it is classified as group 6 and this does not concern this. For this reason, it was filled with the average of weeks of gestation ($\tilde{3}8.94$, was completed as 39 weeks).

3 RESULTS

Performing a simple deterministic imputation, we were able to decrease the missing rate from 42.6 to 0.56%, filling out the observations regarding the data of previous pregnancy, and from 76.97 to 3.91% in observations filled with data on Previous Cesarean sections. After completing the data through deterministic imputation, 5922 valid records were selected, representing 95.34% of the total observations (4.66% of missing values).

Table 2: Table referring to the amount of missing data on the total observations before and after deterministic imputation.

Variable	Missings (%total)	
	data	after imputation
Robson's group	39 (0,6279)	35 (0,5635)
Previous pregnancies	2646 (42,6018)	35 (0,5635)
Previous cesarean sections	4781 (76,9763)	243 (3,9124)

The contribution of each variable to cesarean delivery, including Robson's associated group, described in Table 3, also present another form of interpretation of Robson's groups as it indicated. In it, the groups are also classified as very preventable cesarean section (groups 1, 2, 3 and 4), avoidable (5, 6 and 9) or not avoidable (7, 8 and 10), indicated in the interpre-

tation of RTGC. The probability of significance, p, resulting from statistical tests, Pearson or Fisher, is aggregated. The χ^2, or Pearson test was used in samples with frequencies greater than 20% of the expected frequency in observations per case in contingency tables. This is thus defined because in small samples the approximation of the χ distribution is affected and not considered satisfactory. For the other cases, the exact Fisher test was used (Christensen, 2005).

Table 3: Frequencies and p value produced.

	Values	Cesarean n (%)	$p-value$	Total n (%)
Total		1316 (22.22)		5922 (100)
Number of fetuses	1	1191 (21.31)	<0.001	5589 (98.97)
	2 or more	40 (68.97)		58 (1.03)
Robson Groups	CS very preventable	533 (11.92)	<0.001	4471 (79.17)
	Group 1	159 (9.61)		1654 (29.29)
	Group 2	281 (36.07)		779 (13.79)
	Group 3	37 (2.30)		1608 (28.48)
	Group 4	56 (13.02)		430 (7.61)
	CS avoidable	549 (65.12)		843 (14.93)
	Group 5	406 (58.17)		698 (12.36)
	Group 6	143 (98.62)		145 (2.57)
	Group 9	0 (0)		0 (0)
	CS not preventable	149 (44.74)		333 (5.90)
	Group 7	65 (100)		65 (1.15)
	Group 8	40 (67.80)		59 (1.04)
	Group 10	44 (21.05)		209 (3.70)
Labour	absent	484 (99.38)	0	487 (8.62)
	induced	330 (25.80)		1279 (22.65)
	spontaneous	417 (10.74)		3881 (68.73)
	0	683 (23.57)		2898 (48.94)
Previous deliveries	1	482 (20.65)	0.04	2334 (39.41)
	2 or more	151 (21.88)		690 (11.65)
Pregnancies	1	560 (22.54)		2485 (41.96)
	2	454 (20.94)	0.15	2168 (36.61)
	3	191 (22.82)		837 (14.13)
	4 or more	111 (25.69)		432 (7.29)
	0	806 (15.89)		5073 (85.66)
Previous CS	1	405 (54.51)	<0.001	743 (12.55)
	2 or more	105 (99.06)		106 (1.79)

* CS = cesarean section

In Table 3, it is seen that the highest cesarean section is of the preventable cesarean section group (65.12% of cases). This group is composed of groups 5, 6 and 9, the latter of which had no contribution.

4 DISCUSSION

The largest amount of data taken from the analysis was made due to the missing data on the cesarean section before pregnancy. Although most excluded cases had this characteristic, having previous cesarean section the pregnancy was also the characteristic of the group with the greatest contribution to the performance of cesarean delivery. According to RTGC, 65% of deliveries considered cesarean sections avoidable belong to pregnant women with a history of cesarean section or pregnant women with breech pregnancy with no history of pregnancies. The great contribution of cesarean deliveries in pregnant women who already have a history with this type of delivery, suggests that greater information should be made and implementation of discussions about the dangers that cesarean section causes the pregnant woman and the baby.

Furthermore, may the classification does not reflect the real reasons for a cesarean section to have been performed. Therefore, it cannot be affirmed that the result of the classification in this group is faithful to the condition that the delivery was performed. The inclusion of other variables or alteration of the variables that the classification uses results in a more accurate description, as well as in the reinforcement in the completion of the data.

The high rate of cesarean sections classified as preventable and the lack of completeness and data sharing between hospitals remains worrying and may be related. We believe that measures to cohere and encourage data completion with the possibility of comparing the rates among hospitals should be a main concern and priority in the health area. With increased information sharing between hospitals, the exchange of health strategies increases, which can generate a global improvement in health and data quality indices. To improve it quality and analysis, simple strategies can be adopted such as deterministic imputation ensured the reduction of missing data; which shows the lack of completion of these by hospital units.

Other computer techniques for imputation and discovery of new knowledge, as proposed by the approach of machine learning and data mining techniques, may be another alternative for increasing data quality. Their use in the clinical, medical and data management context can help routine and discover strategies for reducing cesarean rate, for example. As future work, the study of computational techniques used in the obstetric context for imputation or a new discovery in the area will be developed, besides continuing the study and analysis on the significance of obstetric variables in the classification of the type of delivery.

5 CONCLUSION AND FUTURE WORK

Health policy change has encouraged the creation of tools for storing and visualizing data. With the implementation of tools, the analysis of data and especially the quality of data created is made easier. Quality is directly affected by the number of fields filled in by professionals and by the strategies adopted in storage. It can be seen that simple auto complete strategies can be adopted to increase quality. This study showed that identifying simple strategies with deterministic imputation ensured the reduction of missing data. On this case, only 4.66% of the data was discarded.

To add, our study showed the contribution of each group of Robson in the cesarean section and that the group with the highest index is defined as preventable cesarean sections. We also demonstrated that the variables used for this classification are significant to the analysis. This importance is reflected in the addition of features that inform the quality per registration tool. However, there is a significant amount of missing data in basic variables used to study the classification of delivery type. We believe that encouraging data completion with the possibility of comparing data between hospitals should be a priority in the health area.

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