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Original Research Article

Development and validation of software tool for using original Robson ten group classification system for analysing caesarean section rates: a step towards minimizing errors from a large volume centre in a resource country

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ABSTRACT

Background: To develop and validate a software tool for classifying caesarean sections (CS) using original Robson ten group (RTG) system of classification and to compare it with manual entry period using excel sheet.
Methods: The study was conducted in a tertiary care centre to include the data of all women delivered between July 1st 2023 and September 30th 2023. Two months retrospective data was collected for developing the App and it was validated by comparing its accuracy with that of three health care workers. The App was developed to enable classification using a logic-driven if-else condition structure. It was tested in real time for a month period.
Result: A total of 227 deliveries were collected for development of App and it was found to have maximum agreement with that of the gold standard with Kappa score 1, whereas the maximum accuracy of the health workers was 0.933 Kappa score with respect to gold standard. The App was tested in real time and compared with the data entered manually. The misclassification and missing data were nil which used to be 15-20% in groups 2, 10 and 9 when the data were entered manually.
Conclusions: This App was found to be helpful in saving time and minimize human errors in large institutions. It provided accurate data on RTG classification and it ensured all the details for classifying CS are entered. It helps to audit CS systematically.

Keywords: RTGCS, Robson classification, CS, Caesarean audit, Application, App

INTRODUCTION

Caesarean section (CS) is one of the common surgeries done and the rates are increasing worldwide. This is a major concern regarding resources utilized, short term and long-term maternal morbidities. Many countries have exceeded the world health organization (WHO) recommended birth rate of 10-15% with some regions experiencing rates over 40% and currently the ideal number of CS which optimizes maternal and perinatal outcome is unknown.[1-3] The CS rates are an important indicator for measuring obstetric services in any country region or an institution.[4,5] There are different methods to classify/audit CS and each method has its own merits and demerits. WHO has recommended a system for classification of CS-called the Robson's ten group classification system (RTGCS) of CS which classify women into ten mutually exclusive and totally inclusive

groups. Of all the systems used, RTGCS are useful to compare the rates across as well the trends within the health care facility.

Using RTGCS may be difficult in a tertiary care hospital like us as with the annual delivery rate of ~10,000 as all the data are entered by the junior most residents and this can cause room for errors.[6] As hospitals are moving to electronic form of case records and registers in the recent times, there is a scope for developing an App for local use. The App can be used to classify the CS and can be integrated onto existing electronic format if needed. This will minimize the errors in the data entered and the details of CS in this tertiary care centre can be audited in a comprehensive manner.[7]

The aim was to develop and validate a simple system-based software tool for using RTGCS for local use. In addition, additional details like methods of induction and labour outcome will be integrated into the App in a user-friendly manner.

METHODS

The study was carried out after getting approval from scientific and ethics committee. This was a clinical, diagnostic study conducted for a period of three months from July 2023 to September 2023. The data of all consecutive pregnant women delivering after 28 weeks of gestation in one of the six teaching units at women and child block, JIPMER during the study period with the annual delivery rate of 1500. The unit was doing caesarean audit using RTGCS regularly with the data being entered manually in a excel sheet prior to development of this App.

The essential details needed to classify women as per RTGCS included were as follows:[8] Parity, gestational age, mode of labour onset, history of CS in previous pregnancies, fetal lie and presentation and number of foetuses.

In addition, the following additional details which are necessary for auditing caesarean delivery also included in the development of App, methods of induction, indication for induction, mode of delivery, indications for caesarean delivery and neonatal outcome

Data collection and development of App

The retrospective data of two months was used for the development of App. The validation was done subsequently which was followed by testing the App in real time scenario. This helped to develop the App in a user-friendly manner. Also, the App has classification part as per RTGCS and analysis part to get the monthly auditing of CS as mentioned in WHO Robson manual like group size, group CS rate including absolute and relative contribution. The details necessary for the classification of CS as per Robson's method and the other essential details as mentioned were noted down for each woman. The details were used for classification of each woman.

Technique of software tool development based on RTGCS

We employed the Robson 10 classification method to analyze the dataset. To accomplish this, we utilised a series of if-else conditions to determine the appropriate classification group for each patient record. The classification process involved assessing a set of necessary conditions, and only if all these conditions were met, the patient record was assigned to the corresponding Robson group.

This approach allowed the accurate classification of patients based on the Robson 10 criteria using a logic-driven if-else condition structure. The utilization of this approach was aimed at achieving a precise and reliable classification process.

Assessing the performance of developed App

The performance of developed App was used in real time in labour ward for classifying women who deliver over the period of one month on a day-to-day basis. Care was taken to include minimum of 30 different scenarios for each group except groups 6,7 and 9 as the incidence of these groups together is less than 3%.

Statistical analysis

Accuracy was assessed by comparing the correct percentage by software with other three independent healthcare workers using kappa score for interrater reliability.

Ethical considerations and confidentiality

A waiver of consent was obtained as the researcher did not come in contact with the study participants. Confidentiality of the participants will be maintained through the study and even after publishing the results. Their identity was not be disclosed at any point of time.

RESULTS

Data for developing the App

Data regarding a total of 227 deliveries over a period of 2 months were collected retrospectively for the development of the App and the distribution of women in each group are described in Figure 1.

Data for testing the accuracy of the App

A total of 191 deliveries were given to the App and also to three independent health workers (First year residents who used to enter the Robson data manually in the unit) each for testing the accuracy of the application. Residents were

given a reinforcement lesson before the process of classification. The distribution of data in different groups are described in Figure 1.

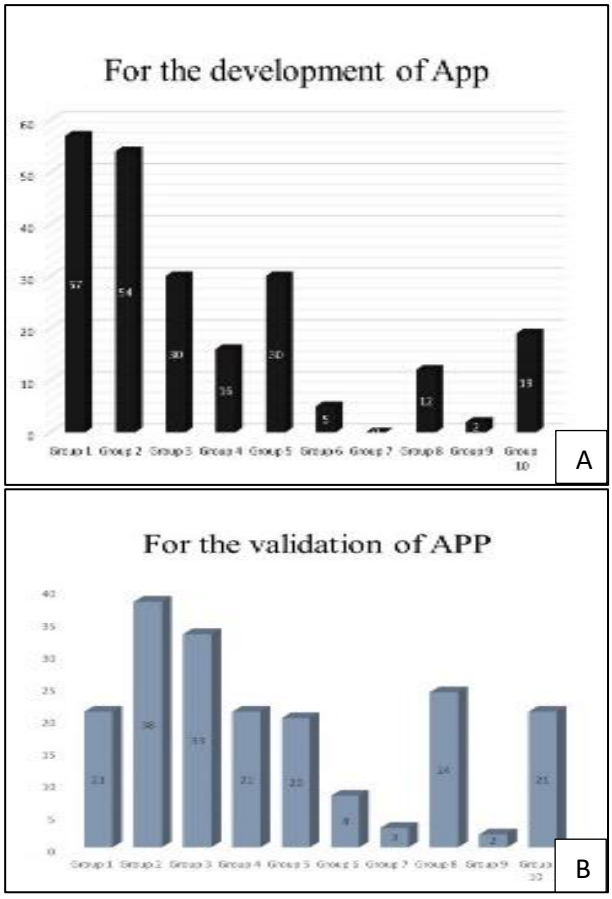

Figure 1: (A and B) Distribution of women of different groups as per RTGCS for development and validation of App.

The level of agreement in determining the Robson group based on the clinical parameters between-Application and resident 1 is found to be 0.933 Kappa statistic with p<0.001, application and resident 2 is found to be 0.86 Kappa statistic with p<0.001, application and resident 3 is found to be 0.861 Kappa statistic with p<0.001, Application and gold standard is found to be 1 Kappa statistic with p<0.001

For resident 1, maximum inaccuracy while classification was found to be in groups 4 with 18 entries correct out of 21 entries (inaccuracy percentage of 14.3%) and group 10 with 18 entries correct out of 21 entries (inaccuracy percentage of 14.3%), for resident 2, maximum inaccuracy was noted in group 7 with 1 correct out of 3 (inaccuracy percentage of 66.7%) and for resident 3, maximum inaccuracy was noted in group 6 with 4 correct entries out of 8 (inaccuracy percentage of 50%) Table 1.

Using application in real time settings

Data regarding a total of 311 deliveries were given to the App over a period of one month to classify when it was used in real time settings. The number of women in each group are depicted in Table 2.

However, when the data were entered in the first half of three weeks, there were a total of 15 cases out of 311 cases that were wrongly classified by the App due to the human error while entering data in the App. These were purely technical. Hence the App has been redesigned by keeping these in mind. Following changes have been made to the App to ensure App is user friendly and captures all data.

Since the same entry was made more than one time, an option for patient identification like a hospital number was introduced for each entry and if there is a double entry it will automatically reflect on the screen. When the user selected spontaneous labour, the page titled induction popped up which led to the user making wrong entries and ultimately led to a wrong classification. Hence a change was made that only if induction of labour was selected, the page titled indications for induction would pop up. Similarly, if prelabour was chosen, then the options of ripening/induction and augmentation will not come. If the user selects primi, option of previous CS would not come because in some cases the difference in the number of CS s resulted in different group allocation. For multiple pregnancy, an option to capture the details of both the babies were included for convenience.

The changes were made in the App and for the next 15 days all the entries made were correctly classified by the App in all the scenarios.

Table 1: Accuracy of developed App compared to residents using Kappa score.

Measures	Value	Asymptomatic standard error	Approximate T	P value
Measure Kappa of agreement between resident 1 and App	0.933	0.019	33.305	0.000
Measure Kappa of agreement between resident 2 and App	0.860	0.027	30.305	0.000
Measure Kappa of agreement between resident 3 and App	0.861	0.027	30.767	0.000
Measure Kappa of agreement between App and gold standard	1.000	0.000	35.698	0.000
Number of valid cases	191			

Table 2: Distribution of women as per RTGCS during the application of App in real time scenario.

Groups	Description	N
1	Nulliparous, single cephalic, ≥37 weeks, spontaneous labour	52
2	Nulliparous, single cephalic, ≥37 weeks, induced or caesarean before labour	55
3	Multiparous (excluding previous caesarean), single cephalic, ≥37 weeks, spontaneous labour	57
4	Multiparous (excluding prev caesarean), single cephalic, ≥37 weeks, induced or caesarean before labour	26
5	Previous caesarean, single cephalic ≥37 weeks	34
6	All nulliparous breeches	10
7	All multiparous breeches (including previous caesarean)	4
8	All multiple pregnancies (including previous caesarean)	34
9	All abnormal lies (including previous caesarean)	3
10	All single cephalic, ≤36 weeks (including previous caesarean)	32
Total number of women classified		311

DISCUSSION

As WHO endorsed the RTGCS, it has become imperative to use the system for collecting the details of CS in any health care facility. This helps us to know the trend in any particular health care facility as well to compare the rates across health care facility. This will allow all clinicians to learn from each other and on the basis of their results examine their practice.[8]

We used to audit CS from the data entered and grouped manually in an excel sheet. Though the residents were primed periodically on RTGCS, there used to be misclassifications of around 10-15% especially in group 2, 4 and 10. There used to be a simplified flow chart pasted near the data entry but the errors were unavoidable. Before auditing, it used to be task to check all the entries were made correctly and grouped accordingly. Sometimes there used to double entries which used to give false information about the auditing. This made us to look for the development of App for auditing CS using RTGCS in a user-friendly manner.

From the results we can understand that there are certain groups of women who are major contributors toward a certain group. Here in this study the major contributors are from group 2 and group 5. This classification can help healthcare workers to plan practical and effective actions targeting specific groups of women to improve maternal and perinatal care.[9]

Healthcare applications based on smart technology have become extremely popular in emergency medical settings in several countries.[10] An application for using RTGCS proves to be extremely useful in a tertiary care institution which sees a large number of deliveries and there is room for manual errors in classification of data. In this study, we found the App to be user friendly, easy to use and time-saving. The App has minimized errors occurring during manual entry to a great extent. It helps in a quick and systematic classification of women into Groups. In the testing phase, the App was rigorously tested by giving various scenarios and we obtained a satisfactory result in which all women were correctly classified.

However, a total of 15 cases were wrongly classified by the App while being used in real time due to the errors while entering data. Keeping these errors in mind the App was redesigned to be more user-friendly and on being tested again, gave correct results as the errors while entering data were reduced to maximum extent.

This App can be integrated with the existing e-confinements of the healthcare facility and can be used for classifying women in other units of the hospital which would help in a systematic and meaningful audit of the CS every month.

Though the existing RTGCS has some limitations and it is modified by including sub groups, the data entered in the App can be downloaded in a spread sheet and subgroup analysis can be done manually. Also, the App included the details of indications for CS, labour induction and methods of induction which are essential for comprehensive auditing of CS. Certain measures can be ensured to reduce the frequency of the CS by periodic auditing.[11]

There are some limitations like the maternal co morbid factors and maternal outcome were not correctly captured in the existing App. But it can be expanded further in its upgradation. We also planned to include the data on high risk factors, maternal outcome and automatic subgroup classifications especially in group 5, 8 and 10 with special focus on methods of induction, labour onset and uterine scar. In addition, in future the application can be developed with some action plans and suggestions to reduce CS according to each group.

CONCLUSION

This study involved the development of a user- friendly Application for RTGCS used for classifying CS based on certain parameters essential for classification and

additional parameters for auditing CS found the App was accurate and useful.

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