Original paper

Validation of RobsApp – audit tool for caesarean section trends

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Abstract

Robson classification is a globally recognised method in systematically classifying all pregnant women admitted for delivery. The World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics (FIGO) recommend the Robson classification as a global standard for assessing, monitoring and comparing CS rates within and between heath care facilities, over time. Continuous audit of admission and delivery data is an essential component in service quality improvements including caesarean section rates. Previously we have reported data acquisition and quality as the main problems in carrying out a continuous audit in absence of a centralised electronic database.

We developed and validated an app based on the hybrid JQuery Mobile (JQM) technology with an option for scalability to the regional and national level in the future for real time acquisition and analysis of admissions data in a maternity care setting using Robson classification.

Key words: Robson classification, caesarean section, validated app, RobsApp, audit tool

Introduction

Robson classification is a system of classifying all women admitted for delivery. It is used globally in many high and low income countries[1]. While it has become a tool mainly used for studying the caesarean section (CS) rates it was first described and used by Dr Michael Robson originally as a system to analyse all labour room and delivery events in an obstetrics unit[2]. It was a clinical attempt rather than a statistical cluster analysis. Authors agreed that the 10 group selection was arbitrary and was based on clinical relevance, ease of use and most importantly the determination of the data quality[3].

While the original purpose of the 10 group classification was the audit and quality improvement of labour and delivery room events in a single Obstetric unit, agreement, standardization and multiple applications

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over the years have converted it into a versatile tool for routine perinatal data collection which is continuous and highly scalable[3,5,6]. This distinction is very important as audit is a continual process and Robson 10 group classification system has become the preferred information technology tool for continuous data collection[5]. The decision to build an information tool for data collection for audit purposes or quality initiatives was based on a recent review of literature on the subject. The selection of Robson Groups was based on its agreement, standardization, user friendliness and versatility or the multiple purposes for which the classification can be used.

Among many CS classification systems (e.g. based on indications for CS, urgency of the CS), the Robson classification is popular in a wider range of settings[4,7]. The World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics (FIGO) also recommend the Robson classification as a global standard for assessing, monitoring and comparing CS rates within heath care facilities, over time and between facilities[8,9].

Users of the 10 group classification by Robson favourably comment on the simplicity, robustness, reproducibility and flexibility of the classification[7]; in fact these were the main objectives of the original designers of the classification. Also, the classification is clinically meaningful and allows the possibility of categorizing women prospectively[6]. This is important from the point of view of randomized control trials as it allows the implementation and evaluation of interventions targeted at specific groups of women.

Development of RobsApp

In view of the multifactorial origins of the rising CS rates and differential impact of the epidemiological, clinical and social determinants on the national CS rates[11] an evidence based approach to the problem of rising CS rates is a must. Any approach to solve the problems requires an ongoing data collection strategy based on accepted standardized criteria so that the outcomes form the baseline and the targets of the interventions can be assessed.

In a study done previously at the same institution, it was reported previously that continued audit should provide the required information, in attempts to reduce the CS rate in the unit which stood at 30% for the period extending from July 2015 to June 2017[10]. In fact the audit was considered the basic unit of action for almost all the 18 recommendations proposed by the study[10].

WHO Robson classification Implementation Manual[6] suggests several methods for data collection in an obstetric unit. The manual method, partial computerized implementations and customized health information technology tools such as an electronic medical record for data collection. The last approach requires extremely sophisticated health information technology which include clinic workflow aligned electronic medical records with advanced application programming interfaces for the tools like Robson Classification to be applied.

Compared to manual classification, automated classification of obstetric patients into Robson groups can potentially improve the efficiency and accuracy of data collection and analysis. There are several approaches that can be taken to automate the classification process, such as the use of machine learning algorithms or natural language processing techniques.

One approach to automating Robson group classification is to use machine learning algorithms to analyse electronic medical records or other data sources. The algorithm can be trained on a dataset of obstetric patients with known Robson group classifications, and then used to predict the Robson group for new patients. Another approach is to use natural language processing (NLP) techniques to automatically extract relevant information from clinical notes or other text-based data sources, and use this information to classify patients into the appropriate Robson group.

But for a LMIC like Sri Lanka where the health information technology has not permeated the health care system to any degree, a partial computerized implementation was deemed more suitable preserving the accuracy of an automated method with a low cost approach.

An app based on the hybrid JQuery Mobile (JQM) technology was planned with an option for scalability to the regional and national level in the future. This web application will be referred to as "RobsApp" and the technical details and specifications are shown in the accompanying Figures 1-10 and explained in the methods section.

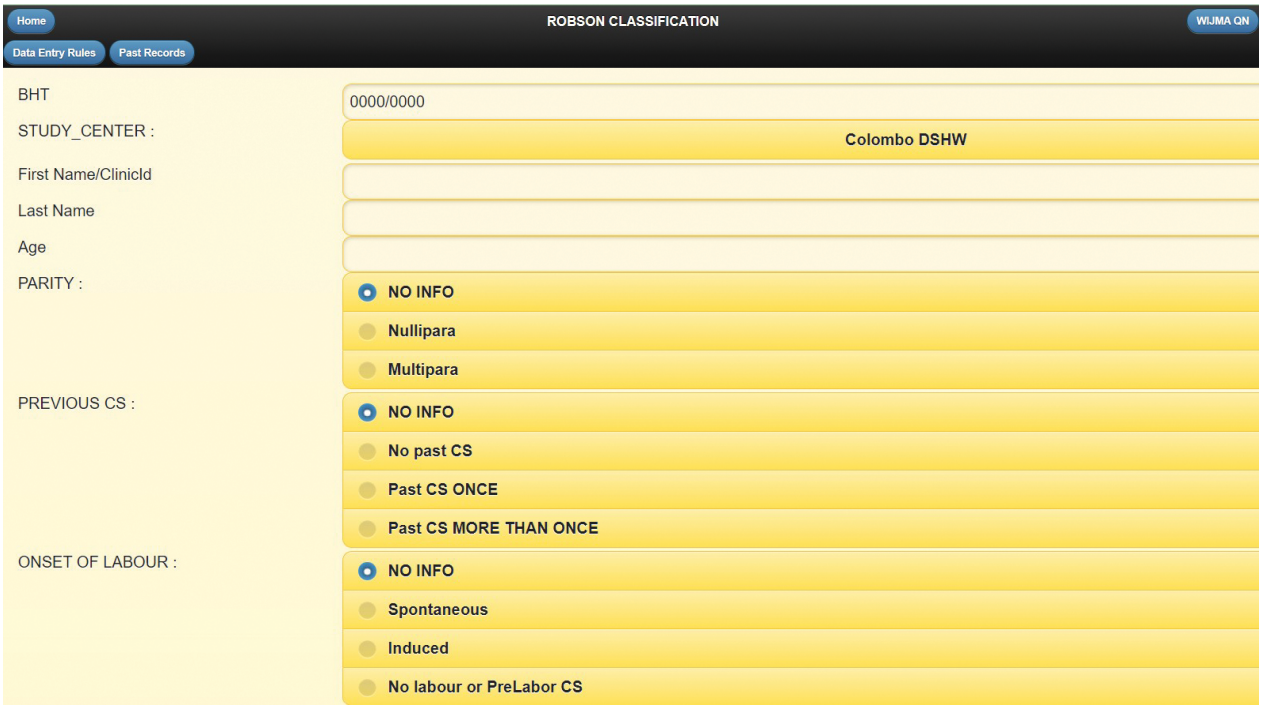
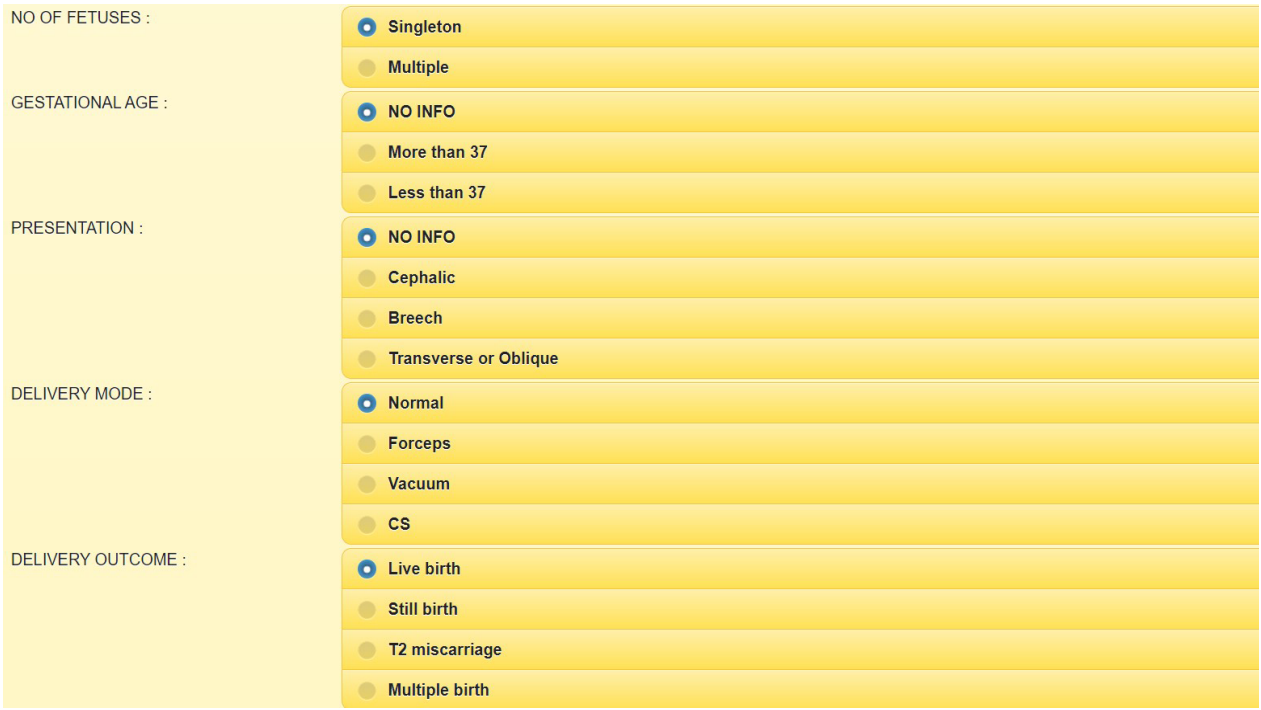


Figure 1.



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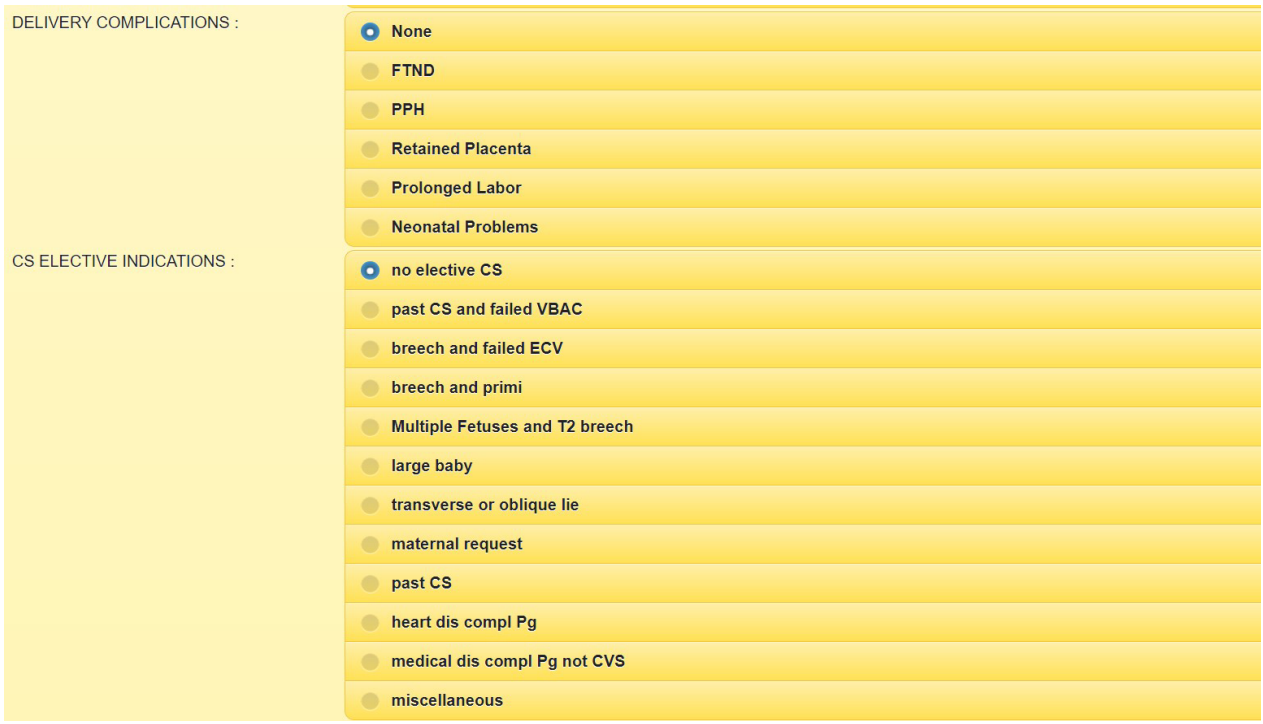

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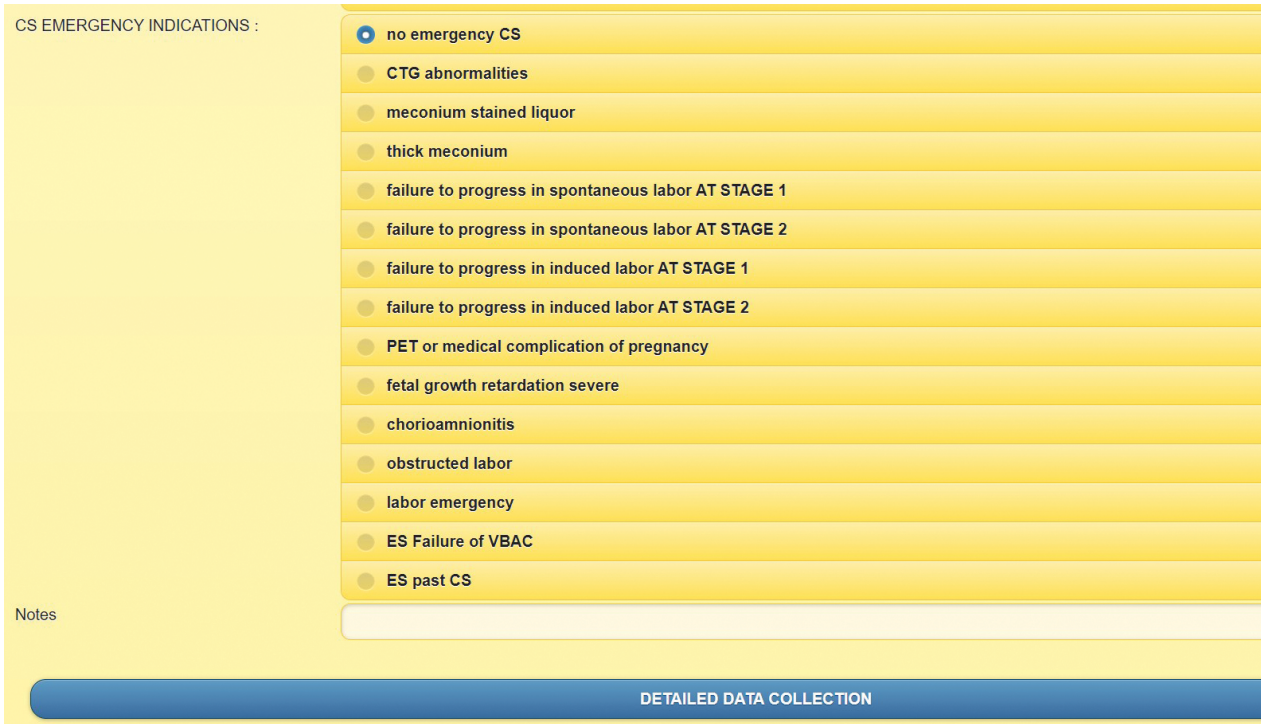

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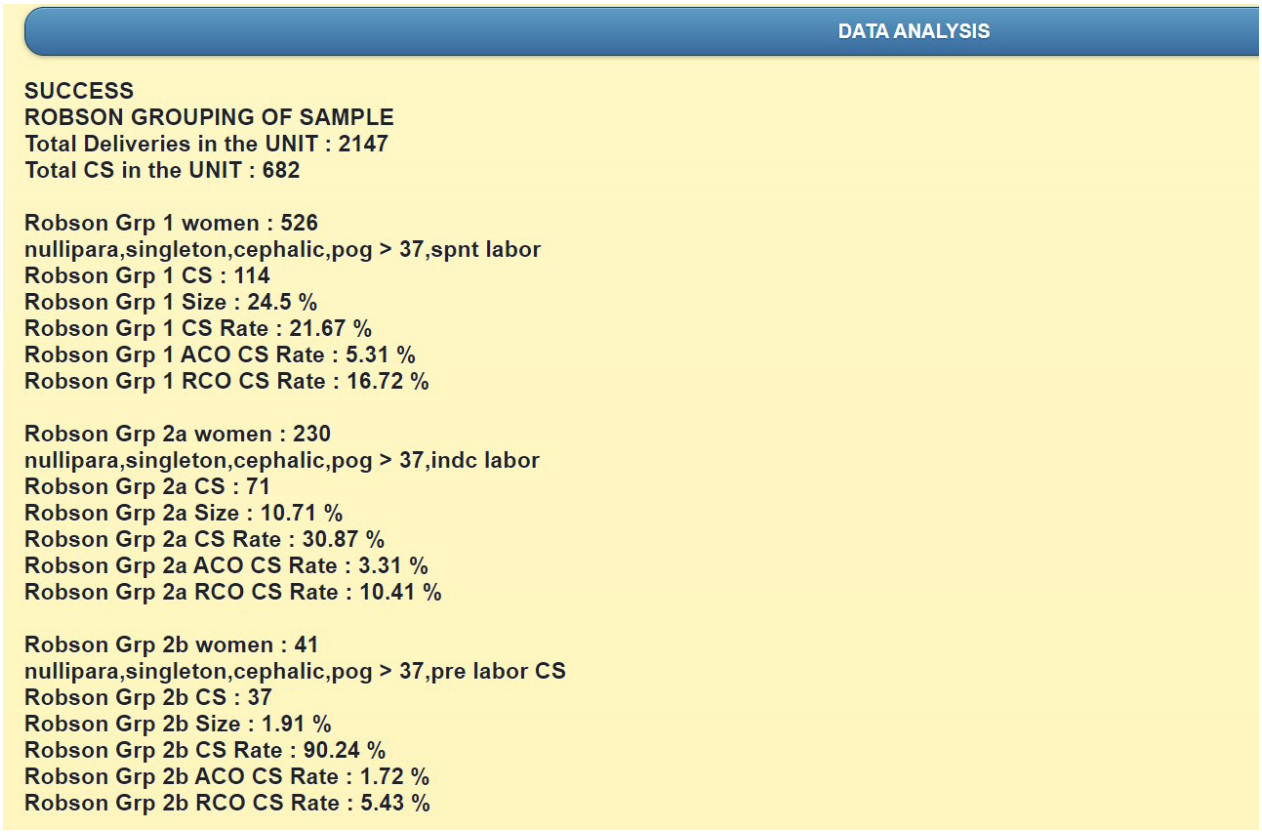

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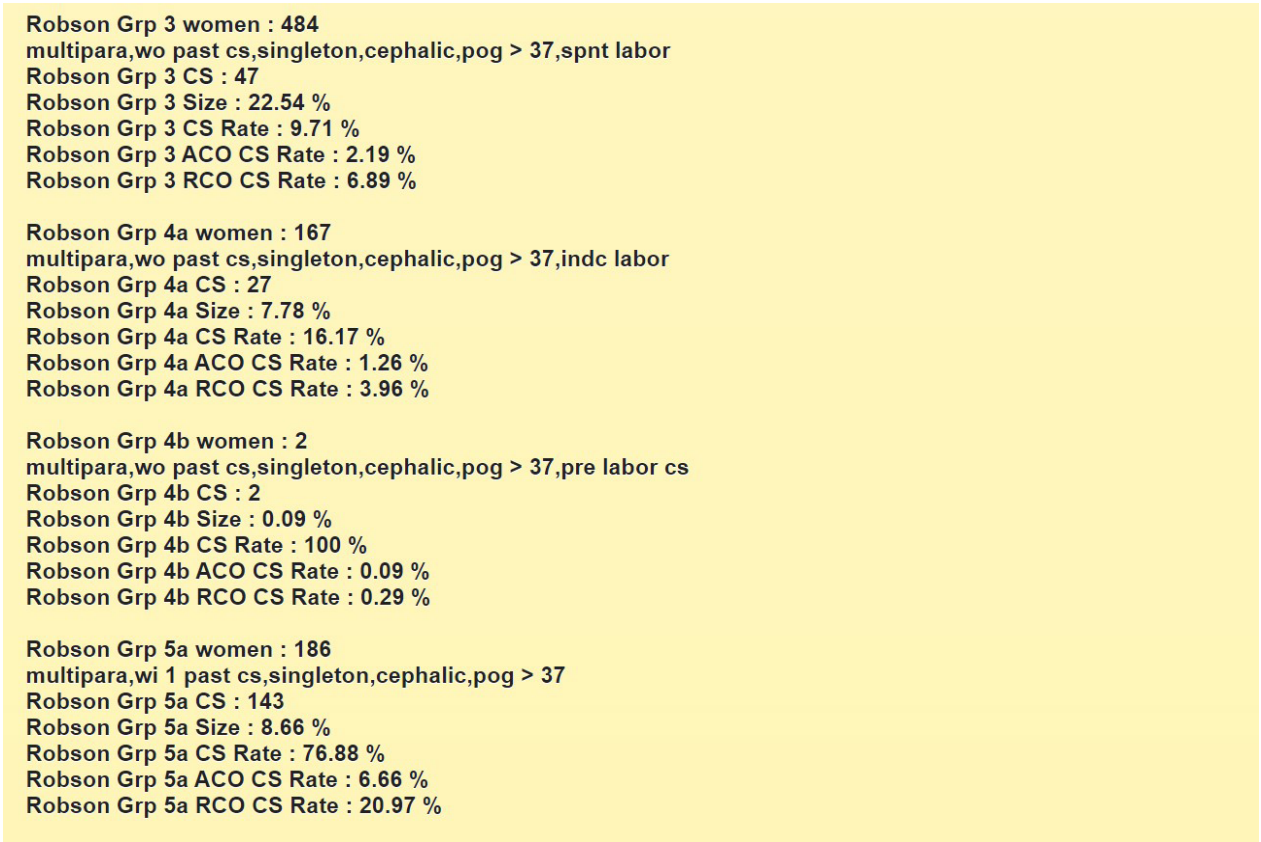


Figure 6.

Robson Grp 5b women : 46
multipara,wi 2 or more past cs,singleton,cephalic,pog > 37
Robson Grp 5b CS : 43
Robson Grp 5b Size : 2.14 %
Robson Grp 5b CS Rate : 93.48 %
Robson Grp 5b ACO CS Rate : 2 %
Robson Grp 5b RCO CS Rate : 6.3 %

Robson Grp 6 women : 42
nullipara,singleton,breech
Robson Grp 6 CS : 39
Robson Grp 6 Size : 1.96 %
Robson Grp 6 CS Rate : 92.86 %
Robson Grp 6 ACO CS Rate : 1.82 %
Robson Grp 6 RCO CS Rate : 5.72 %

Robson Grp 7 women : 41
multipara,singleton,breech,wi past cs
Robson Grp 7 CS : 36
Robson Grp 7 Size : 1.91 %
Robson Grp 7 CS Rate : 87.8 %
Robson Grp 7 ACO CS Rate : 1.68 %
Robson Grp 7 RCO CS Rate : 5.28 %

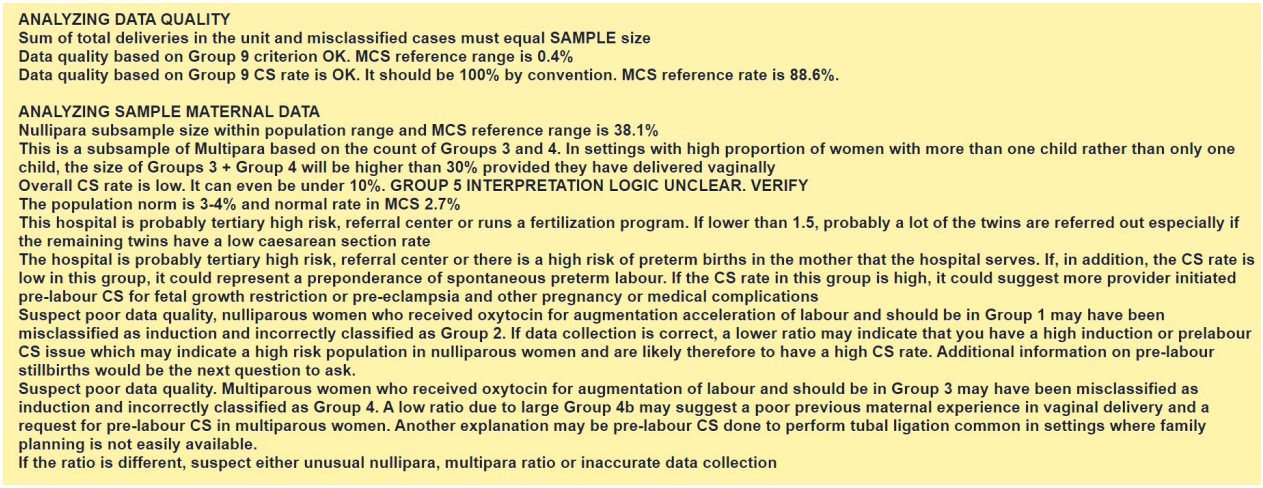
Robson Grp 8 women : 46
multiple pregnancy
Robson Grp 8 CS : 30
Robson Grp 8 Size : 2.14 %
Robson Grp 8 CS Rate : 65.22 %
Robson Grp 8 ACO CS Rate : 1.4 %
Robson Grp 8 RCO CS Rate : 4.4 %

Figure 7.

Robson Grp 9 women : 9
ALL,singleton,Tr or Ob lie
Robson Grp 9 CS : 9
Robson Grp 9 Size : 0.42 %
Robson Grp 9 CS Rate : 100 %
Robson Grp 9 ACO CS Rate : 0.42 %
Robson Grp 9 RCO CS Rate : 1.32 %

Robson Grp 10 women : 172
ALL,singleton,cephalic,POG less than 37
Robson Grp 10 CS : 84
Robson Grp 10 Size : 8.01 %
Robson Grp 10 CS Rate : 48.84 %
Robson Grp 10 ACO CS Rate : 3.91 %
Robson Grp 10 RCO CS Rate : 12.32 %

Figure 8.



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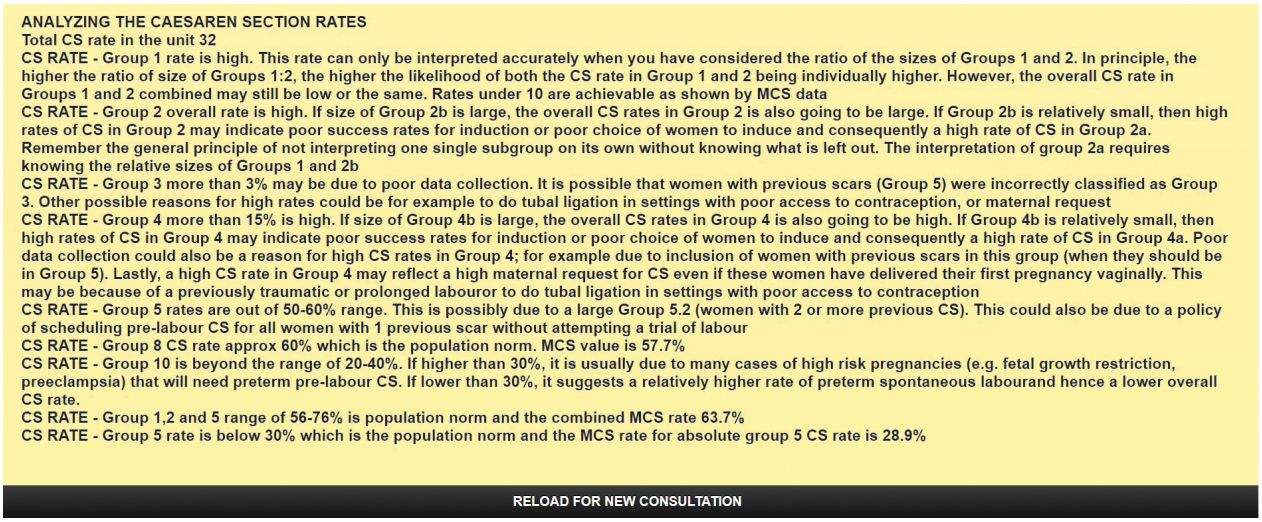

Figure 10.

Based on the digital health implementations checklist by the WHO in 2019[12], RobsApp was designed with accurate content from the WHO Manual, industry standards of software development principles and was deployed in an enabling environment of governance and policies in a University based tertiary care obstetric unit as suggested by Senanayake et al, in a previous study[10].

Objectives

The main objective of the study is to validate the RobsApp; a health information technology tools for obstetric audit.

Methodology

Study setting

University obstetric unit in the De Soysa Hospital for Women (DSHW) – a tertiary care teaching hospital in Sri Lanka.

Sampling techniques

Convenient sample of unduplicated, unselected, consecutive wards admission for pregnancy and delivery.

Sample size

Sample size was calculated based on the expected percentage of positive ratings by the two raters per Robson's category, expected kappa coefficient, null value for the kappa coefficient and the power of the study using the recommendations of Sim and Wright (2005). Accordingly expecting a positive rating percentage of 10%, expected kappa coefficient of 0.7, a null value of 0 and a power of 90%, the sample size required per Robson's category was 22. To accommodate for all 13 Robson's categories, a total sample of 286 was considered as sufficient.

An app (RobsApp) based on the WHO Robson Classification: Implementation Manual 2017[6] was designed and developed for the purpose of classifying all the mothers admitted for delivery in the unit with the objective of conducting audits for the caesarean section rates, which was on the increase. Data was collected by departmental research assistants (MBBS qualified) after attending a training session conducted by a specialist obstetrician and the app developer.

Parity, previous caesarean sections (CS), onset of labour, number of foetuses, gestational age, fetal lie and presentation were the main variables collected to classify the mothers in the unit.

The values of the above independent variables were the same as those suggested by the WHO Manual[6]. The app also collected the following variables – delivery mode, delivery outcome, delivery complications, elective CS indication and emergency CS indications. Each woman entered into the study was allocated to a Robson group by the RobsApp.

The raters for the study were practicing specialist obstetricians who independently categorised the same study participants to Robsons 10 group classification using data available with patient records.

Using the RobsApp generated classification of the mothers in the unit, mothers are separated into 2 major groups – first comprising the groups 6-10 and the second comprising the groups 1-5 respectively referred to as Obstetric High Risk Group (OHRG) and Obstetric Low Risk Group (OLRG). The specialist Obstetrician in charge of the unit makes an endorsement in the BHT-OHRG if the mother is having multiple pregnancy OR transverse or obstetric lie OR breech OR gestational age less than 37 weeks and OLRG if none of these variables are observed.

Using the RobsApp generated classification of the mothers in the unit after the mothers are separated in the OHRG and OLRG groups a second validation is done on the detailed subtypes of the OLRG group. This group according to the Robson 10-group classification can further be subdivided into interventional and spontaneous labour groups where interventional group comprises the induction of labour or pre-labour CS. The specialist Obstetrician in charge of the unit makes an endorsement in the BHT in the OLRG group whether intervention positive or negative. Intervention is positive when induction of labour is done or a pre-labour CS is planned.

Using a 2×2 contingency table a kappa statistic will be calculated to ascertain the RobsApp and specialist Obstetrician agreement corrected for chance. The kappa statistic will be interpreted as Landis and Koch criteria.

Results

WOMAN'S PROFILE	GROUP
Nullipara, singleton, cephalic, POG > 37 wk, spontaneous labour	1
Nullipara, singleton, cephalic, POG > 37 wk, induced labour	2a
Nullipara, singleton, cephalic, POG > 37 wk, pre-labour CS	2b
Multipara, no past CS, singleton, cephalic, POG > 37 wk, spontaneous labour	3
Multipara, no past CS, singleton, cephalic, POG > 37 wk, induced labour	4a
Multipara, no past CS, singleton, cephalic, POG > 37 wk, pre-labour labour	4b
Multipara, 1 past CS, singleton, cephalic, POG > 37 wk, ANY labour	5a
Multipara, 2 or more past CS, singleton, cephalic, POG > 37 wk, ANY labour	5b
Nullipara, singleton, breech	6
Multipara, singleton, breech, past CS, ANY POG, ANY labour	7
Multiple pregnancy	8
Transverse or oblique lie	9
ANY parity, singleton, cephalic, POG less than 37	10

Figure 11.

Table 1. Robson's categories as determined by the consultant's assessment

Robson's category	Description	Frequency	Percentage
1	Nullipara, singleton, cephalic, POG>37 wks, spontaneous labour	63	21.0
2a	Nullipara, singleton, cephalic, POG>37 wks, induced labour	47	15.7
2b	Nullipara, singleton, cephalic, POG>37 wks, pre-labour CS	3	1.0
3	Multipara, no past CS, singleton, cephalic, POG<37 wks, Spontaneous labour	64	21.4
4a	Multipara, no past CS, singleton, cephalic, POG<37 wks, Induced labour	35	11.7
4b	Multipara, no past CS, singleton, cephalic, POG<37 wks, pre-labour CS	1	.3
5a	Multipara, 1 past CS, singleton, cephalic, POG<37 wks, ANY labour	40	13.3
5b	Multipara, 2 or more past CS, singleton, cephalic, POG<37 wks, ANY labour	14	4.7
6	Nullipara, singleton, breech	8	2.7
7	Multipara, singleton, breech, past CS, ANY POG, ANY labour	6	2.0
8	Multiple pregnancy	6	2.0
9	Transverse of oblique lie	2	.7
10	ANY parity, singleton, cephalic, POG less than 37	11	3.7
	Total	**300**	**100.0**

Nearly 70% of all deliveries were in the categories of 1, 2a, 3 and 5a out of which 36% comprised nullipara and 34% multipara women according to the study VOGs. As Table 2 shows these same categories had a very high kappa value (above 0.8) for interrater agreement. It is also notable however that all the other values for the interrater agreement had been above 0.75, All kappa coefficients were statistically significant.

Discussion

The overall agreement between the RobsApp classification of women and that of the study VOGs is high all above 90% except one group where it was above 80%. The inter-rater agreement between the RobsApp and the specialist obstetricians was above 0.90 in case of Robson groups 5b, 6-10. In case of Robson groups 1,2,3 and 5a it was above 0.80. there is a substantial to almost perfect agreement between the RobsApp and the specialist obstetricians on the classification of women into Robson groups corrected for chance.

RobsApp is an app which attempts automation of Obstetric audit in general and monitoring the rising CS rates in particular. In view of the popularity of the instrument and also the scope of obstetric application for quality improvement and monitoring we thought an automation of the Robson grouping in contrast to manual classifications which is the current metho-

Table 2. Agreement and Kappa statistic of the Robson's categories using the RobsApp and the consultant's assessment

Robson's category	Percentage agreement	Kappa statistic	Significance
1	84.3%	0.83	P<0.001
2a	94.6%	0.82	p<0.001
3	93.7%	0.81	P<0.001
4a	95.3%	0.77	p<0.001
5a	97.6%	0.89	P<0001
5b	99.7%	0.96	P<0.001
6	99.7%	0.94	P<0.001
7	99.7%	0.92	P<0.001
8	99.7%	0.92	P<0.001
9	100.0%	1.0	P<0.001
10	99.3%	0.91	P<0.001

dological approach in almost all the studies on Robsons app is a timely need. We could find only 2 more studies which attempted automation of Robson Classification of the mothers admitted for delivery.

In one study[14] (Triep et al. 2020) the approach was to automate classification of all women admitted to obstetric units at the stage of epidemiological survey of all hospital admissions. This is of necessity a retrospective approach and depends on the availability of data at that stage. An approach based on SQL query development was used to classify all women admitted for delivery. While the approach was successful by the validation reported, its application beyond the research and at a national level is largely unfeasible as all institutions need to provide the required data on a regular basis.

In another study[15] (Rudey et al. 2020) an approach was to educate and train the ward staff in using the Robson classification through a dedicated website. Then a special form for national live birth data was designed which was completed and returned by all the obstetric units. The success of this program depends on so many persons and methodological integrity of data along the pathway from delivery room to the epidemiology statistical unit.

Current study used a sample of 300 records and in this sample, some of the rare Robson's categories were underrepresented, which could be a limitation of the study.

Conclusion

Based on the results of this study it appears that RobsApp has sufficient credibility to be used in obstetric unit audits in Sri Lanka. The rising CS rates can now be analyzed based on the WHO criteria almost effortlessly. The audit can be incorporated into the routine ward workflow without much hassle, but an onsite data entry mechanism must be implemented. The design principles ensure that the app can also be used to analyze the CS trends in the unit, among units in a major hospital, in a region or else even nationally.

Study setting

De Soysa Hospital for Women, Colombo.

Financial support

No financial support or grants used.

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