

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 health 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 countries¹. 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 unit². 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 quality³.

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 collection⁵. 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 health 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 classification⁷; 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 prospectively⁶. 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 rates¹¹ 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 2017¹⁰. In fact the audit was considered the basic unit of action for almost all the 18 recommendations proposed by the study¹⁰.

WHO Robson classification Implementation Manual⁶ 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.

Home		ROBSON CLASSIFICATION		WIJMA QN	
Data Entry Rules		Past Records			
BHT	0000/0000				
STUDY_CENTER :	Colombo DSHW				
First Name/ClinicId					
Last Name					
Age					
PARITY :	<input checked="" type="radio"/> NO INFO <input type="radio"/> Nullipara <input type="radio"/> Multipara				
PREVIOUS CS :	<input checked="" type="radio"/> NO INFO <input type="radio"/> No past CS <input type="radio"/> Past CS ONCE <input type="radio"/> Past CS MORE THAN ONCE				
ONSET OF LABOUR :	<input checked="" type="radio"/> NO INFO <input type="radio"/> Spontaneous <input type="radio"/> Induced <input type="radio"/> No labour or PreLabor CS				

Figure 1.

NO OF FETUSES :	<input checked="" type="radio"/> Singleton <input type="radio"/> Multiple
GESTATIONAL AGE :	<input checked="" type="radio"/> NO INFO <input type="radio"/> More than 37 <input type="radio"/> Less than 37
PRESENTATION :	<input checked="" type="radio"/> NO INFO <input type="radio"/> Cephalic <input type="radio"/> Breech <input type="radio"/> Transverse or Oblique
DELIVERY MODE :	<input checked="" type="radio"/> Normal <input type="radio"/> Forceps <input type="radio"/> Vacuum <input type="radio"/> CS
DELIVERY OUTCOME :	<input checked="" type="radio"/> Live birth <input type="radio"/> Still birth <input type="radio"/> T2 miscarriage <input type="radio"/> Multiple birth

Figure 2.

DELIVERY COMPLICATIONS :	<input checked="" type="radio"/> None <input type="radio"/> FTND <input type="radio"/> PPH <input type="radio"/> Retained Placenta <input type="radio"/> Prolonged Labor <input type="radio"/> Neonatal Problems
CS ELECTIVE INDICATIONS :	<input checked="" type="radio"/> no elective CS <input type="radio"/> past CS and failed VBAC <input type="radio"/> breech and failed ECV <input type="radio"/> breech and primi <input type="radio"/> Multiple Fetuses and T2 breech <input type="radio"/> large baby <input type="radio"/> transverse or oblique lie <input type="radio"/> maternal request <input type="radio"/> past CS <input type="radio"/> heart dis compl Pg <input type="radio"/> medical dis compl Pg not CVS <input type="radio"/> miscellaneous

Figure 3.

CS EMERGENCY INDICATIONS :	<input checked="" type="radio"/> no emergency CS <input type="radio"/> CTG abnormalities <input type="radio"/> meconium stained liquor <input type="radio"/> thick meconium <input type="radio"/> failure to progress in spontaneous labor AT STAGE 1 <input type="radio"/> failure to progress in spontaneous labor AT STAGE 2 <input type="radio"/> failure to progress in induced labor AT STAGE 1 <input type="radio"/> failure to progress in induced labor AT STAGE 2 <input type="radio"/> PET or medical complication of pregnancy <input type="radio"/> fetal growth retardation severe <input type="radio"/> chorioamnionitis <input type="radio"/> obstructed labor <input type="radio"/> labor emergency <input type="radio"/> ES Failure of VBAC <input type="radio"/> ES past CS
Notes	
DETAILED DATA COLLECTION	

Figure 4.

DATA ANALYSIS

SUCCESS**ROBSON GROUPING OF SAMPLE**

Total Deliveries in the UNIT : 2147

Total CS in the UNIT : 682

Robson Grp 1 women : 526
 nullipara, singleton, cephalic, pog > 37, spnt labor
 Robson Grp 1 CS : 114
 Robson Grp 1 Size : 24.5 %
 Robson Grp 1 CS Rate : 21.67 %
 Robson Grp 1 ACO CS Rate : 5.31 %
 Robson Grp 1 RCO CS Rate : 16.72 %

Robson Grp 2a women : 230
 nullipara, singleton, cephalic, pog > 37, indc labor
 Robson Grp 2a CS : 71
 Robson Grp 2a Size : 10.71 %
 Robson Grp 2a CS Rate : 30.87 %
 Robson Grp 2a ACO CS Rate : 3.31 %
 Robson Grp 2a RCO CS Rate : 10.41 %

Robson Grp 2b women : 41
 nullipara, singleton, cephalic, pog > 37, pre labor CS
 Robson Grp 2b CS : 37
 Robson Grp 2b Size : 1.91 %
 Robson Grp 2b CS Rate : 90.24 %
 Robson Grp 2b ACO CS Rate : 1.72 %
 Robson Grp 2b RCO CS Rate : 5.43 %

Figure 5.

Robson Grp 3 women : 484
 multipara, wo past cs, singleton, cephalic, pog > 37, spnt labor
 Robson Grp 3 CS : 47
 Robson Grp 3 Size : 22.54 %
 Robson Grp 3 CS Rate : 9.71 %
 Robson Grp 3 ACO CS Rate : 2.19 %
 Robson Grp 3 RCO CS Rate : 6.89 %

Robson Grp 4a women : 167
 multipara, wo past cs, singleton, cephalic, pog > 37, indc labor
 Robson Grp 4a CS : 27
 Robson Grp 4a Size : 7.78 %
 Robson Grp 4a CS Rate : 16.17 %
 Robson Grp 4a ACO CS Rate : 1.26 %
 Robson Grp 4a RCO CS Rate : 3.96 %

Robson Grp 4b women : 2
 multipara, wo past cs, singleton, cephalic, pog > 37, pre labor cs
 Robson Grp 4b CS : 2
 Robson Grp 4b Size : 0.09 %
 Robson Grp 4b CS Rate : 100 %
 Robson Grp 4b ACO CS Rate : 0.09 %
 Robson Grp 4b RCO CS Rate : 0.29 %

Robson Grp 5a women : 186
 multipara, wi 1 past cs, singleton, cephalic, pog > 37
 Robson Grp 5a CS : 143
 Robson Grp 5a Size : 8.66 %
 Robson Grp 5a CS Rate : 76.88 %
 Robson Grp 5a ACO CS Rate : 6.66 %
 Robson Grp 5a RCO CS Rate : 20.97 %

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.

ANALYZING DATA QUALITY

Sum of total deliveries in the unit and misclassified cases must equal SAMPLE size

Data quality based on Group 9 criterion OK. MCS reference range is 0.4%

Data quality based on Group 9 CS rate is OK. It should be 100% by convention. MCS reference rate is 88.6%.

ANALYZING SAMPLE MATERNAL DATA

Nullipara subsample size within population range and MCS reference range is 38.1%

This is a subsample of Multipara based on the count of Groups 3 and 4. In settings with high proportion of women with more than one child rather than only one child, the size of Groups 3 + Group 4 will be higher than 30% provided they have delivered vaginally

Overall CS rate is low. It can even be under 10%. GROUP 5 INTERPRETATION LOGIC UNCLEAR. VERIFY

The population norm is 3-4% and normal rate in MCS 2.7%

This hospital is probably tertiary high risk, referral center or runs a fertilization program. If lower than 1.5, probably a lot of the twins are referred out especially if the remaining twins have a low caesarean section rate

The hospital is probably tertiary high risk, referral center or there is a high risk of preterm births in the mother that the hospital serves. If, in addition, the CS rate is low in this group, it could represent a preponderance of spontaneous preterm labour. If the CS rate in this group is high, it could suggest more provider initiated pre-labour CS for fetal growth restriction or pre-eclampsia and other pregnancy or medical complications

Suspect poor data quality, nulliparous women who received oxytocin for augmentation acceleration of labour and should be in Group 1 may have been misclassified as induction and incorrectly classified as Group 2. If data collection is correct, a lower ratio may indicate that you have a high induction or prelabour CS issue which may indicate a high risk population in nulliparous women and are likely therefore to have a high CS rate. Additional information on pre-labour stillbirths would be the next question to ask.

Suspect poor data quality. Multiparous women who received oxytocin for augmentation of labour and should be in Group 3 may have been misclassified as induction and incorrectly classified as Group 4. A low ratio due to large Group 4b may suggest a poor previous maternal experience in vaginal delivery and a request for pre-labour CS in multiparous women. Another explanation may be pre-labour CS done to perform tubal ligation common in settings where family planning is not easily available.

If the ratio is different, suspect either unusual nullipara, multipara ratio or inaccurate data collection

Figure 9.

ANALYZING THE CAESAREAN SECTION RATES

Total CS rate in the unit 32

CS RATE - Group 1 rate is high. This rate can only be interpreted accurately when you have considered the ratio of the sizes of Groups 1 and 2. In principle, the higher the ratio of size of Groups 1:2, the higher the likelihood of both the CS rate in Group 1 and 2 being individually higher. However, the overall CS rate in Groups 1 and 2 combined may still be low or the same. Rates under 10 are achievable as shown by MCS data

CS RATE - Group 2 overall rate is high. If size of Group 2b is large, the overall CS rates in Group 2 is also going to be large. If Group 2b is relatively small, then high rates of CS in Group 2 may indicate poor success rates for induction or poor choice of women to induce and consequently a high rate of CS in Group 2a.

Remember the general principle of not interpreting one single subgroup on its own without knowing what is left out. The interpretation of group 2a requires knowing the relative sizes of Groups 1 and 2b

CS RATE - Group 3 more than 3% may be due to poor data collection. It is possible that women with previous scars (Group 5) were incorrectly classified as Group 3. Other possible reasons for high rates could be for example to do tubal ligation in settings with poor access to contraception, or maternal request

CS RATE - Group 4 more than 15% is high. If size of Group 4b is large, the overall CS rates in Group 4 is also going to be high. If Group 4b is relatively small, then high rates of CS in Group 4 may indicate poor success rates for induction or poor choice of women to induce and consequently a high rate of CS in Group 4a. Poor data collection could also be a reason for high CS rates in Group 4; for example due to inclusion of women with previous scars in this group (when they should be in Group 5). Lastly, a high CS rate in Group 4 may reflect a high maternal request for CS even if these women have delivered their first pregnancy vaginally. This may be because of a previously traumatic or prolonged labour or to do tubal ligation in settings with poor access to contraception

CS RATE - Group 5 rates are out of 50-60% range. This is possibly due to a large Group 5.2 (women with 2 or more previous CS). This could also be due to a policy of scheduling pre-labour CS for all women with 1 previous scar without attempting a trial of labour

CS RATE - Group 8 CS rate approx 60% which is the population norm. MCS value is 57.7%

CS RATE - Group 10 is beyond the range of 20-40%. If higher than 30%, it is usually due to many cases of high risk pregnancies (e.g. fetal growth restriction, preeclampsia) that will need preterm pre-labour CS. If lower than 30%, it suggests a relatively higher rate of preterm spontaneous labour and hence a lower overall CS rate.

CS RATE - Group 1,2 and 5 range of 56-76% is population norm and the combined MCS rate 63.7%

CS RATE - Group 5 rate is below 30% which is the population norm and the MCS rate for absolute group 5 CS rate is 28.9%

RELOAD FOR NEW CONSULTATION

Figure 10.

Based on the digital health implementations checklist by the WHO in 2019¹², 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 study¹⁰.

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 2017⁶ 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 Manual⁶. 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 Robson's 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<0.001
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 study¹⁴ (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 study¹⁵ (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.

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