

# Short message service (SMS) as an educational tool during pregnancy: A literature review

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## Abstract

**Background:** In many low- and middle-income countries, access to health information during pregnancy is poor. The rapid adoption of mobile phones in these countries has created new opportunities for disseminating such information.

**Objective:** This paper reviews existing information on the use of short message services (SMSs) as a feasible tool to transmit health education information.

**Methods:** The PubMed, Cochrane library, EMBASE and Google scholar databases were searched for studies in which mobile phone SMSs were used to promote health education during pregnancy. Studies of adult women, from any setting, who received SMS health education messages during their pregnancy, were included, irrespective of study design.

**Results:** The analysis of results followed a narrative synthesis approach, a textual approach involving a synthesis of findings from multiple studies. The synthesis was developed manually, based on the extraction of data. All studies demonstrated use or interest in SMS technology to facilitate health information messaging. Findings from several studies showed that pregnant women were both receptive and willing to use SMS technology to enhance their health. In Zanzibar, the effect of SMS on skilled delivery rates and access to emergency healthcare was assessed. The effects SMS alerts had on hospital deliveries and SMS interventions had on facility use during pregnancy were assessed in Rwanda.

**Conclusion:** The review highlights the practicality and willingness of utilising SMS technology to promote or enhance health education.

## Keywords

Evidence review, health education, narrative synthesis pregnancy, SMS, women

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## Introduction

Lower- to middle-high-income countries (LMICs) account for 99% of all maternal deaths, with nearly three-fifths of the maternal deaths occurring in Sub-Saharan Africa alone, where maternal mortality is 1 in 150, as compared to 1 in 3,800 in high-income countries (World Health Organization Fact Sheet, 2012).

In many LMICs, access to health information during pregnancy is hard to access. Approximately 25% of the world's adult population is illiterate, of which two-thirds are women (Kickbusch, 2001); in LMICs, there is a strong and consistent correlation between adult female literacy and women's well-being. In South Africa, the female literacy rate is 80%, compared to Niger where the literacy rate is only 10% (Van der Berg, 2002). In Niger and Burkina Faso, only 10% of women can read and write, and a mother's education level is closely correlated to the risk of child's death before the age of 2 years (Kickbusch, 2001).

It might be assumed that low literacy levels will also have an impact on women's understanding of text-based messages. Gazmararian et al. (2014) observed higher literacy to be associated with successful enrolment in the text4baby programme, and when there are poor low literacy levels it requires all short message services (SMSs) be appropriately phrased for health message communication (Poorman et al., 2014). Past studies have also shown that there are high risks of mortality among children aged less than 5 years whose mothers had no schooling, in India (Das Gupta, 1990). The factors mentioned may be exogenous, but it is important that they be emphasised, given their importance in facilitating health education via SMS.

The rapid adoption of mobile phones in the developing countries has created new opportunities for disseminating health education information to large populations at a low cost (GSMA: African Mobile Observatory, 2011). Available mobile phone coverage is estimated at 6.8 billion mobile subscriptions worldwide in 2014 (ITU World Telecommunications/ICT Indicators database, 2014), and expected increased coverage of mobile subscriptions particularly in LMICs offers unprecedented opportunities for mHealth, in which mobile phones and tablets support medical and public health practice to bridge the gaps in knowledge of pregnant women (Lester et al., 2010).

SMS interventions can, in principle, reach either the general population or specific populations, including those most at risk and people living in hard-to-reach areas. The mass broadcast of SMS health messages could ensure that all pregnant women with mobile phones are able to receive reminders and information regarding health (Patrick et al., 2008). Similarly, the implementation of the SMS to health staff members can assist in increased two-way communication with patients, thus reducing delays in the communication of urgent health information to healthcare practitioners and their patients (Lund et al., 2012). The main advantages of using SMS messages for educational health information are their low cost and broad reach. SMS lower barriers to driving transformative social change using mobile technologies. Therefore, the aim of this review was to determine whether the use of SMS technology or the willingness to use SMS technology in LMICs could enhance health education during pregnancy.

## Methodology

This study took the form of a literature review. The outcomes for the review sought to determine (1) whether SMS technology would be an effective tool for the administration of health information or the interest thereof during pregnancy and (2) whether SMS technology is effective enough to sustain relevant changes in behaviour.

### *Search strategy and selection criteria*

The search strategy was designed to identify studies in which mobile phone SMS had been used to promote health education during pregnancy and/or questionnaires, interviews and focus groups had been used to determine the level of interest of pregnant women in receiving SMS (see Appendix 1).

We searched PubMed, Cochrane library, EMBASE and Google Scholar to identify all relevant studies available on 23 January 2014. The search terms used were kept consistent and were run in all databases (see Appendix 1). There were no limitations/restrictions set on the year of the study and language. Study inclusion criteria were as follows: (1) studies assessing the interest of pregnant women to use SMS technology, (2) studies assessing SMS technology for health education in pregnant women and (3) studies assessing the effectiveness of SMS for health education in pregnant women. Studies that involved the use of SMS in chronic and infectious diseases and the promotion of lifestyle changes through SMS systems were also included.

The exclusion criteria were as follows: (1) SMS studies in men, (2) SMS studies in non-pregnant women, (3) SMS studies done on contraception, (4) telecommunication and use of websites, (5) SMS studies prior/after the pregnancy period without sending SMS during pregnancy, (6) SMS reminders were not considered as part of health education unless the messages were used to support or improve antenatal care (ANC) attendance and (7) SMS interventions in adolescents to prevent pregnancy through the use of contraception.

The effectiveness of the use of SMS was considered. Studies that used SMS as an intervention that was directed at general infant care (for example, skin care) were excluded.

Participants included pregnant women who had completed questionnaires, interviews and focus groups on their willingness to receive health SMS and those who received SMS health clinic reminders during their pregnancy. The primary outcome of interest was whether SMS could offer a practical method of conferring health information to pregnant women, which was assessed through the reception or willingness of the women to use SMS technology as a tool to enhance health education in pregnant women.

Study quality was assessed based on the objectivity of the outcome assessment and completeness of outcome data (see Appendix 2 and also <http://www.cochrane-handbook.org>). Development of the search terms was undertaken by K.L., K.S. and K.K.-G. The search was conducted by K.L. Article titles and abstracts were evaluated by K.L. Study quality was assessed through the use of an adapted Cochrane quality tool (Higgins and Green, 2011). Data quality was assessed by K.L. and S.P.

### *Data extraction and management*

References were managed using RefWorks. All search outputs and results were imported to RefWorks and duplicates were deleted. A standard data collection form was used to extract descriptive information and outcome data from each of the articles that were included. For each study, we extracted the following information: citation, study design and methodology, key points/objectives of the article, limitations of the study and findings. Two authors (K.L. and K.K.-G.) extracted descriptive and outcome data for each included article using a standardised data collection form, resolving any discrepancies by discussion and consensus. K.K.-G. cross-checked the data summarised in the tables to ensure that there were no errors. The interpretation of the data was undertaken by K.L., S.S. and K.K.-G. All authors read the paper, commented on the content and approved the final version.

## Synthesis of research findings

The analysis of results followed a narrative synthesis approach, which is a textual approach of a synthesis of findings from multiple studies (telling the story) of findings from the included structures. The synthesis was developed manually based on the extraction of data (Popay et al., 2006).

## Results

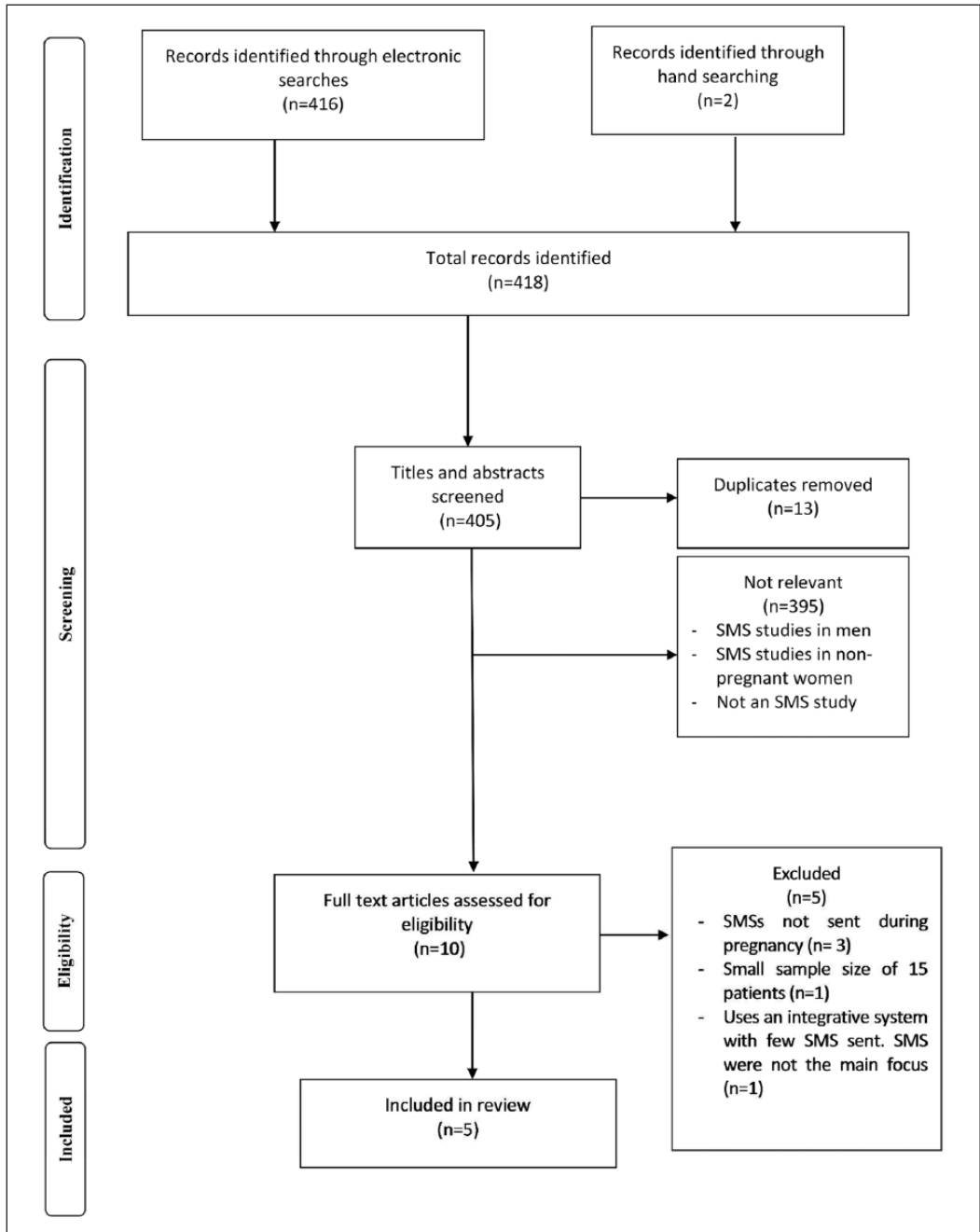
### *Inclusion of studies*

A total of 416 records were identified through the search of the electronic databases and two records were identified through hand searching, giving a total of 418 records, of which 13 were duplicates. After removing the duplicates, the titles and abstracts of the remaining records were screened and 395 clearly irrelevant records were excluded. The full text of the remaining 10 articles was retrieved and assessed in detail. The inclusion criteria for articles for the current review were as follows: (1) studies assessing the interest of pregnant women to use SMS technology, (2) studies assessing SMS technology for health education in pregnant women and (3) studies assessing the effectiveness of SMS for health education in pregnant women. Five potentially eligible articles did not meet the inclusion criteria and were excluded, resulting in five articles being included in the current review (see Figure 1). The exclusion criteria were defined as follows and have been added in the method section. The excluded studies were based on the following: (1) SMS studies in men, (2) SMS studies in non-pregnant women, (3) SMS studies done on contraception, (4) telecommunication and use of websites, (5) SMS studies prior/after the pregnancy period without sending SMS during pregnancy and (6) SMS reminders were not considered as part of health education unless the messages were used to support or improve antenatal clinic attendance. Study selection followed two stages: first, abstracts were screened for relevance and second, the full text articles were read and thereafter the inclusion and exclusion criteria were applied. Of note, although we did not restrict this study selection to a particular period, all studies included were carried out from 2000 onwards. This could be due to SMS usage in clinics and hospitals being a fairly new method of distributing health educational information, which was not widely available before 2000. This would account for the published literature only gaining momentum from this period onwards.

Detailed assessment of the five publications (Table 1) included in the review identified the following themes:

*SMSs are an effective tool for the administration of health information to pregnant women.* Gazmararian et al. (2014) assessed factors related to the enrolment process and reception of health tips via SMS in pregnant women attending two clinics in Atlanta, USA. Women received 3-weekly short messages, which included reminders, health tips and medical warning signs that women should be aware of during pregnancy. The findings from the conducted survey showed low health literacy levels among women, possibly related to educational attainment and socioeconomic status. Of all the women, 95% received the short text messages that were sent to them without interruption, 92% of all the SMSs were opened and read and 88% of the pregnant women who received messages enrolled on the studies' website to continue receiving health SMS ((Gazmararian et al., 2014).

*SMS interest: the willingness to receive SMS during pregnancy.* Cormick et al. (2012) evaluated the attitude and willingness of pregnant women to receive health educational material via SMS. Pregnant women were recruited from two different hospitals in Rosario (Argentina) – 147 pregnant



**Figure 1.** PRISMA flow diagram for the study search and selection process.

women completed questionnaires, of which 93.2% had mobile phones, mostly prepaid phones. Of the pregnant women from both hospitals, 77% were interested in receiving an SMS once a week. Only questionnaires were filled and no SMSs were sent (Cormick et al., 2012).

Table 1. Characteristics of studies included in this review.

Study	Type of setting	Study type	Countries' income	Intervention	Outcome
Ngabo et al. (2012)	Primary healthcare	Survey An SMS-based system was developed to improve MCH using RapidSMS®, a free and open-sourced software development framework. The RapidSMS-MCH system was customised to allow interactive communication between a CHW following mother–infant pairs in their community.	LMIC Rwanda	A total of 432 Community Health Workers were trained and equipped with mobile phones. A total of 35,734 SMS were sent between May 2010 to April 2011. A total of 11,502 pregnancies were monitored. 362 SMS alerts for urgent and life-threatening events were registered. Two-way SMS system, maternal risks were highlighted to women and were informed of serious symptoms to be reported to midwife.	Successfully designed and implemented a mobile phone SMS-based system to track pregnancy and maternal and child outcomes in limited resources setting. A 27% increase in facility-based delivery from 72% twelve months before to 92% at the end of the 12 months pilot phase Increase in healthcare facility usage from 8%–28% to 72%–92%.
Naughton et al. (2012)	National Health Service centre	A randomised controlled trial was undertaken in which pregnant smokers were allocated to receive MiQuit, a tailored self-help leaflet followed by an 11-week programme of tailored text messages or to a control group, receiving a nontailored self-help leaflet.	HIC England, UK	Participants (N=207) were recruited from seven NHS Trusts in the south east, east, and north east of England, UK. Within the MiQuit intervention arm (N=100). Sent regular SMSs, women were followed up by the midwife after 3 months via telephone call.	Women enrolled into MiQuit programme were more likely to stop smoking. 9% of women discontinued the SMS. 22.9% stopped smoking from SMSs sent.

**Table 1.** (Continued)

Study	Type of setting	Study type	Countries' income	Intervention	Outcome
Cormick et al. (2012)	Public hospital	Survey Questionnaires were verbally administered to pregnant women who were attending an antenatal care visit in community health centres and public hospitals.	LMIC Argentina	N= 147 pregnant women meeting inclusion criteria (Rosario: 63; Mercedes: 84) were approached and verbally consented to participate. Questionnaires and interviews were conducted to determine women's interest in SMS. Ninety-six percent of women (n = 140) responded that they would like to receive text messages and mobile phone calls with information regarding prenatal care.	The vast majority of interviewed women had access to and were interested in receiving text messages and calls with educational information regarding pregnancy and infant health; pregnant women in Argentina could benefit from such an mHealth programme. 96% of the women wanted to receive an SMS. Most women on average stayed 43 min away from hospital in urban areas.
Gazmararian et al. (2014)	Primary healthcare	Survey The text4baby evaluation was conducted in two WIC clinics in Metro Atlanta Nutrition education is a vital component of the Maternal health Health Federally Funded WIC programme and WIC regulations require that at least two nutrition classes are available for WIC recipients every 6-month certification period; Atlanta WIC clinics mandate attendance in one nutrition class in this period.	HIC USA	468 participants completed the baseline survey, of whom 351 completed the 1-week survey, and 209 completed the 2-month survey. Women had the option of enrolling for the text messages via texting 'baby' at the 511.411 number or enrolling online (text4baby website). Determined who wanted to receive an SMS, sent SMSs and follow-up calls were done after 3 months.	42% of the women had some college education and 82% had household income=\$20,000. About half attempted text4baby self-enrolment (162/351), with enrolment success more likely among women with more education (80% with some college vs. 62% with less education). Enrolment success was relative to educational statuses. 88% of all women read the SMS.

(Continued)

Table 1. (Continued)

Study	Type of setting	Study type	Countries' income	Intervention	Outcome
Lund et al. (2012)	Primary healthcare	Cluster-randomised controlled trial with primary healthcare facilities in Zanzibar as the unit of randomisation. 2,550 pregnant women (1,311 interventions and 1,239 controls).	LMIC Zanzibar	N= 2,637 Control = 1,351 Intervention = 1,286 SMS sent during pregnancy by midwife, adverse maternal outcomes explained to women and 42-day follow-up post-pregnancy.	Mobile phone intervention was associated with an increase in antenatal care attendance. In the intervention group, 44% of the women had four or more antenatal care visits vs. 31% in the control group (OR, 2.39; 95% CI, 1.03–5.55). There was a trend towards improved timing and quality of antenatal care services (ns). 53% had mobiles accessible. 37% owned their own mobile. 9% increase in skilled delivery and a reduction in pregnancy complication from 11.5% to 7.5% was observed.

SMS: short message service; MCH: maternal and child health; LMIC: lower- to middle-high-income country; CHW: community health worker; WIC: Women, Infants and Children; NHS: National Health Service; OR: odds ratio; CI: confidence interval; ns: not significant; HIC: high income countries.



Lund et al. (2012), in a large-scale randomised controlled trial which included 2,500 pregnant women in 24 healthcare facilities in Zanzibar, assessed the effect of SMS on skilled delivery rates and access to emergency healthcare. The women were followed up by midwives 42 days post-pregnancy. If any women experienced pain or problems (warning signs) related to the risks that had been delineated by the midwife, the midwife received an SMS from the women explaining their symptoms; the midwife would contact the doctor and ambulance. The effectiveness of this system increased the patients' confidence and trust in their midwives. Pregnancy complications were reduced by 42% through the utilisation of this system, and antenatal healthcare was improved by 91% and institutional deliveries by 51%, respectively (Lund et al., 2012). The approach used in Lund et al. (2012) study was pragmatic and randomised the health facilities, rather than individuals, to prevent a potential spill-over effect from the intervention to the control group. It is also important to note that not all the women owned their mobile phones; sometimes, the phones were co-owned by other family members; this is a limitation.

Ngabo et al. (2012) assessed a newly designed rapid SMS-based alert system in Rwanda customised to be interactive between the community and the community healthcare worker to monitor pregnancies and to allow for contact with the community healthcare centre in case of emergencies. Four hundred thirty-two healthcare workers were trained and 11,502 pregnancies were monitored. The SMSs were also sent out as reminders for clinic visits. The findings demonstrated an increase in assisted deliveries in health facilities by 72%–92%. Prior to the study, this number ranged from 8% to 28%. When women were not in good health, they sent danger signs and 30% of all these cases were haemorrhages. The only limitation of the study was when an ambulance was outside of the network range, the system used could fail in triggering the emergency obstetric care. This would cause delays, thus the solution used was to forward the ambulance requests to at least one additional individual at the district health office. This was automated in the system prior to scale-up (Ngabo et al., 2012).

*SMS technology promotes a sustainable behaviour change for risk mitigation.* Naughton et al. (2012) evaluated, in a randomised clinical trial, the use of tailored leaflets compared to SMS-based text messages to facilitate smoking cessation in pregnant women. A randomised controlled trial was undertaken in which pregnant smokers were allocated to either receive MiQuit, a tailored self-help leaflet followed by an 11-week programme of tailored text messages, or to a control group, receiving a nontailored self-help leaflet. Participants were 207 pregnant smokers identified by community midwives across seven National Health Service (NHS) Trusts (UK). At 3-month follow-up, intervention acceptability, cognitive determinants of quitting and smoking outcomes (self-reported and cotinine-validated 7-day point prevalence abstinence) were assessed. The findings of the study by Naughton et al. (2012) indicate that the delivery of smoking cessation support by tailored leaflet and text message to pregnant smokers is feasible and acceptable. Only 9% of the women that entered the study discontinued. The findings suggest that MiQuit had positive effects on three cognitive determinants that were key intervention targets: self-efficacy, harm beliefs and determination to quit. MiQuit also increased the likelihood of setting a quit date. The limitation of the MiQuit study was the recruitment strategy; the recruitment forms were not completed systematically.

## Discussion

The current review highlights the potential of short message services as a tool to increase the efficacy of delivering health information to facilitate increased maternal knowledge and increased health facility utilisation for overall improved maternal and neonatal health outcomes. To date, there are

very few articles on the use of SMSs as a vehicle to increase health knowledge and potentially change behaviour during pregnancy; the few identified published peer-reviewed studies, however, indicate great interest in SMS support during pregnancy and postpartum. There are inadequate data in the field of SMS technology and health education in pregnant women; furthermore, the methodology of many of the studies remains elusive and suggests that there is room for better-designed, more meticulous studies to compare the outcome of pregnant women who receive health information via SMS versus those who do not.

SMS technology has been shown to be a feasible method for the administration of health educational messages. Of women who received a health tip, 90% opened and read the SMS sent (Cormick et al., 2012). Nevertheless, the frequency of the SMS sent should be one to three times a week, to avoid repetition and irritation. Ideally, women should be able to choose when and how frequently they would prefer to receive an SMS to keep them motivated. As a consequence of high uptake of mobile phones in LMICs, mobile-based educational schemes have an opportunity to enhance health behaviour, and therefore health outcomes, at the population level.

A limitation of sending SMSs is that there are only 160 characters to send an accurate healthcare message that is comprehensive. The best way to mitigate this problem is to use a two-way SMS system, which should be free for patients to ask questions, if there is uncertainty or a lack of clarity in an SMS sent. A toll-free number allowing women to express their questions or concerns would also be a viable solution. It is also important that the SMS be tailored for specific women, especially those that require motivational messages, reminders or alerts as demonstrated in the MiQuit study (Naughton et al., 2012).

The study by Lund et al. (2012) elucidated how a simple SMS provides education to pregnant women and improved clinic attendance, in a low-income country. This provided evidence that interventions effectively utilised can improve antenatal services. SMS technology can positively influence health-seeking behaviour and satisfaction in low-resource settings. Mobile technologies make people more contactable and as such offer a useful tool to deliver education and improve health-seeking behaviour or health-related lifestyle decisions (Free et al., 2013). Education during ANC is important for the health of the pregnant women and the unborn baby. In South Africa, mobile phone penetration is high; health promotion via SMS advances the right access to health information. A controlled clinical trial was carried out, the intervention group received SMS messages and the control group received no SMS messages. There was no difference demonstrated between the control and intervention groups (Pan African Clinical Trials Registry).

Evidence suggests that educational levels are also not a strong determinant of who reads health SMSs because women with low literacy levels, from a poor socioeconomic status, read and open SMS sent. This is an indication that SMS technology reaches those from disadvantaged backgrounds (Gazmararian et al., 2014). However, further insight is required to optimise the uptake of SMS messages to influence perception, accessibility and subsequently efficacy of SMS to support and sustain behaviour change and essentially improve maternal outcomes.

In Rwanda, usage of health facilities, attendance rate and access to emergency healthcare were all improved through the use of an interactive SMS platform strengthening, in addition, the relationship between the pregnant women and their midwives (Ngabo et al., 2012). In this LMIC setting, it was very difficult for the midwife to follow up all the pregnant women with a telephone call. Telephone maintenance was a common challenge reported because their phones needed to be charged more regularly, in areas where access to electricity in a number of communities was difficult. It was recommended that mobile phones be charged at their closest health centre but the distance travelled to the centre was too extensive, again providing a strong case for the use of SMS

technology as a more effective health education tool in LMIC. Health teaching is essential for the patients who need care and it is one of the most important roles of being a healthcare professional. Through the use of SMS, the nurses and midwives could give health information to their clients even if at home and it could help them to give knowledge about their disease, thus exploiting promising instruments as basis for health literacy, dependency and technology competence of the patients (Klasnja and Pratt, 2012).

In conclusion, the use of SMS technology to disseminate health information is a most promising interactive approach to healthcare, improved monitoring of pregnant women and increased health-care surveillance.

### Ethics approval

This was a review of already published literature. Nonetheless, because the review was part of the new recently implemented, Pregnancy-Related Obesity Prevention through Technology in Africa (PROTECT AFRICA) study, it was approved by the Human Research Ethics Committee (HREC) of the University of Cape Town and complies with the Declaration of Helsinki (ethics number 140/2013).

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**Appendix 1.** Search terms.

	Query
#1	Low-income country OR lower-income country OR third-world country OR middle-income country and SMS and pregnancy
#2	High-income country OR middle/high-income country and SMS and pregnancy
#3	Low-income country OR lower-income country OR third-world country OR middle-income country and SMS and health education and pregnancy
#4	High-income country OR middle/high-income country and SMS and health education and pregnancy
#5	SMS health education and pregnancy
#6	SMS intervention and pregnancy
#7	SMS and health education and regular antenatal visits

**Appendix 2.** Quality assessment of studies included in the review (risk of bias).

Study	Completeness of data	Origin of data (database of measurements)	Type of research Blinding of researcher/ clinician	Is there a clear definition of outcome?	Confounders taken into account?
Lund et al. (2012)	No missing data	Own data	No blinding on patients and nurses	Primary and secondary outcome was well defined	Confounders were removed
	Low Risk	Low Risk	High Risk	Low Risk	High Risk
Ngabo et al. (2012)	No clear mention of loss to Follow up	Own data	None	Not defined	None described
	High Risk	Low Risk	High Risk	High Risk	High Risk
Cormick et al. (2012)	Survey	Own data	Survey, No blinding	Not defined	None described
	Low Risk	Low Risk	High Risk	High Risk	High Risk
Naughton et al. (2012)	Loss to follow up	Own data	Concealed from Nurses, patients, research staff and patients	Primary and secondary outcome	None described
	High Risk	Low Risk	Low Risk	Low Risk	High Risk
Gazmararian et al. (2014)	Survey	Own data	No admission	Primary outcome defined	None mentioned
	Low Risk	Low Risk	High Risk	Low Risk	High Risk