REVIEW

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Efficacy of communication interventions for promoting blood donation in low- and middle-income countries: A systematic review

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Abstract

Background and Objectives: In low- and middle-income countries (LMICs), information on the efficacy of communication interventions promoting blood donation is very scarce. The present review aimed to identify specific communication interventions and their efficacy for increasing blood donation in LMICs.

Materials and Methods: The databases searched were PubMed, Scopus, PsycINFO, Web of Science, CINAHL, ProQuest, AJOL and CAB Abstracts. Grey literature sources included the websites of African Society of Blood Transfusion, International Society of Blood Transfusion and World Health Organization. The outcomes of interest were donation attempt or actual blood donations.

Results: A total of 16 studies including nine randomized controlled trials (RCTs) were included in the review. The communication interventions included social media and mass media, such as radio and television, as platforms for promoting blood donation,

and newspaper articles or advertisements as an incentive for donor recruitment. Mobile text messages were used either alone or in combination with phone calls, and other interventions such as meetings and brochures. Only three of the 16 studies specifically targeted behavioural science theories, and none of the 16 studies used any implementation science framework. For some communication interventions, there was evidence of statistically significant increases in donations, but the quality of the studies was weak.

Conclusion: The efficacy of communication interventions for promoting blood donations in LMICs remains limited due to few rigorous studies. More rigorous, theory-based studies on the use of communication interventions to increase blood donation in LMICs, especially in sub-Saharan Africa where no prior RCT were identified, are needed.

Keywords

blood donation, communication interventions, low- and middle-income countries

Highlights

- In low- and middle-income countries (LMICs), information on the efficacy of communication interventions promoting blood donation is very scarce.
- We identified 16 studies, including nine randomized controlled trials, on communication interventions for promoting blood donation in LMICs, but the quality of the studies was weak.
- There is a need for rigorous, theory-based studies on the use of communication interventions to increase blood donation in LMICs.

INTRODUCTION

Inadequate blood supply to meet transfusion needs is a common problem primarily affecting low- and middle-income countries (LMICs)—defined based on World Bank income classification—and they are unable to achieve donation targets of at least 1% of total population donating blood [1]. A recent modelling study showed that many LMICs in regions such as sub-Saharan Africa (SSA) and South Asia had insufficient blood to meet their transfusion needs [2]. Thus, interventions for promoting blood donation in LMICs are urgently needed.

Communication interventions are essential to encourage new blood donors and retain existing ones, but research into what communication interventions work in LMICs is lacking. For example, three reviews of blood donation in SSA described communication interventions for promoting blood donation but did not assess their effectiveness [3–5]. An enhanced focus on donor communications research was specifically identified by the National Institutes of Health as one of several key research priorities to address blood availability and transfusion safety in LMICs [6]. A review of self-reported motivators and deterrents for blood donation in Ghana also identified the importance of marketing communication [7]. Moreover, LMICs have been largely under-represented in studies of communication interventions to promote blood donation [8–13].

A robust investigation of the efficacy and effectiveness of diverse communication strategies to promote blood donation in LMICs will help prioritize which approaches are best suited to increase the blood supply. The need for such evidence is most acute in LMICs because they have the biggest problem with blood availability. Moreover, beliefs and perceptions about blood donation in LMICs [4] and resource constraints mean that interventions that work in high-income countries may not work in LMICs [6]. For example, in SSA, people may be unwilling to donate blood because of several beliefs, including the perception that donated blood would be used for rituals [4].

Also, it is unknown whether communication interventions for promoting blood donation in LMICs are based on socio-behavioural theories and implementation science frameworks. Evidence-based socio-behavioural interventions are often anchored in theories, thus aiding their subsequent testing [14]. Assessing implementation science in communication interventions on blood donation could help generate factors that influence their uptake in real-world settings [15], making a need for identifying implementation science frameworks in such interventions critical. As a first step in this endeavour, the primary goal of this review is to identify gaps or opportunities in communication interventions that may be used to promote blood donor recruitment and retention in LMICs.

MATERIALS AND METHODS

The protocol for this systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO,

CRD42022328809) on 10 May 2022. We conducted the systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines [16].

Literature search

We searched PubMed, Scopus, PsycINFO, Web of Science, CINAHL, ProQuest, AJOL and CAB Abstracts. In addition, we searched other relevant sources of grey literature such as the websites of African Society of Blood Transfusion, International Society of Blood Transfusion, Vox Sanguinis and World Health Organization (WHO). The searches were conducted in two phases from January to June 2022, and updated in March 2023 for papers published until December 2022. Our search strategy included search terms around two concepts: blood donation and communication interventions. An exhaustive list of relevant keywords and medical subject heading (MeSH) terms, when applicable, were used during the systematic

searches across databases. Retrieved bibliographic citations of the literature were imported to Rayyan—a systematic review management software.

Study selection

The selection of the studies was based on their relevance to the purpose of the review. An initial screening of titles and abstracts identified papers for full-text review (see Figure 1 for the selection process).

We considered papers published in only English because the research team was not proficient in other official languages. We included studies of communication interventions that focused on donor recruitment (encouraging non-blood donors to become blood donors) and retention (encouraging previous blood donors to become repeat blood donors) and that reported quantitative outcomes such as attempted or successful blood donations.
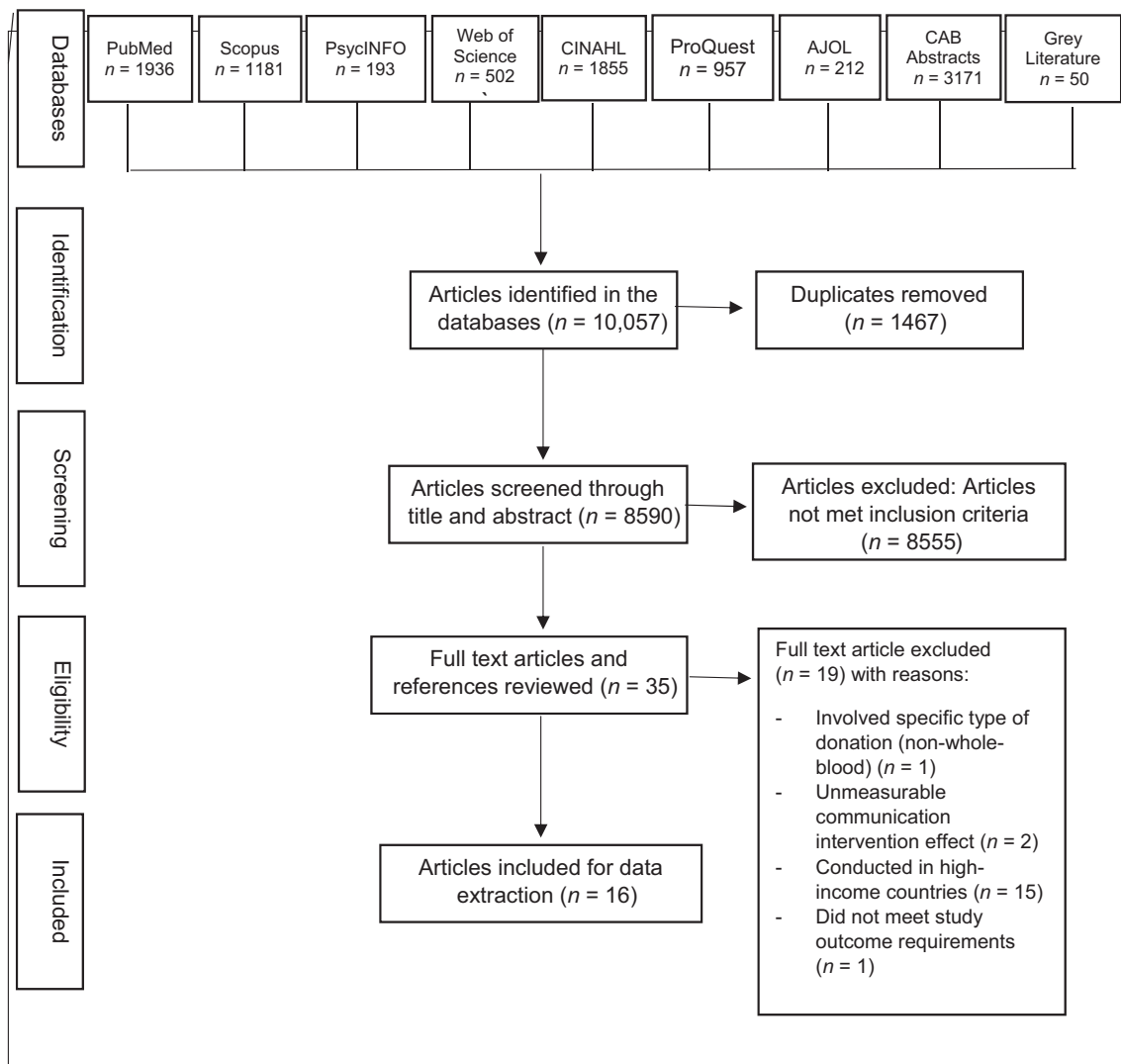

FIGURE 1   Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) flow chart.

In terms of study designs, we included randomized controlled trials (RCTs), quasi-experimental studies (i.e., non-randomized cohort or prospective) and pre-/post-outcomes-based observational designs with or without controls.

We excluded studies that were not conducted in LMICs, did not assess communication interventions aimed at blood donation, were multi-factorial such that the effect of specific communication interventions could not be separated out from other intervention methods, or were restricted to non-whole-blood donations such as apheresis. Studies with outcomes such as blood donation attempt or number of successful blood donations that were not measured quantitatively, or were based on self-reported intention or willingness to become new or repeat donor, were also excluded.

Outcomes

Our primary outcomes of interest were the number or proportion of people who attempted or successfully donated blood. Other relevant outcomes selected were the number or proportion of people who registered at blood donation drives.

Population and intervention

Following the World Bank income category classification of LMICs, we considered non-blood donors, active blood donors and non-active prior blood donors as participants. The World Bank income category classification was used because a previous systematic review on interventions to increase blood donation among ethnic or racial minorities [11] focused on only high-income countries using this classification. We considered five main types of communication interventions: (a) mass media (i.e., radio, television or newspapers); (b) social media (defined as an interactive web and mobile channels for sharing, discovering, co-creating, or exchange information, ideas, photos or videos within a virtual network); (c) phone-based intervention outside of social media (e.g., text messaging or making phone calls); (d) drama- or theatre-related intervention; and (e) in-person or face-to-face communication, including public outreach programmes. We considered these five communication channels because a previous systematic review on blood donation and culture identified them as key for promoting blood donation in low-resource settings [3].

Screening, data collection and analysis

We used Rayyan, an online systematic review management software, for initial screening by titles and abstracts [17]. Two reviewers (M.K.A. and G.S.) independently screened the studies manually, meaning a blind review was conducted without using any automatic screening processes. Arbitration or conflict regarding study inclusion was resolved through discussion and by a third review by B.A.

Data extraction and management

A data extraction matrix using Google form was created. Data extraction was independently performed by two authors (M.K.A. and G.S.). Arbitration or disagreement during data extraction was critically reviewed and resolved by the lead author (B.A.). The data extraction matrix included objective, population, setting, design, group allocation, type and mode of communication intervention, use of theory, measures of exposure and outcome, sample size, statistical analysis and result. Three authors were in regular communication throughout the data extraction phase (M.K.A., G.S. and B.A.).

Risk of bias assessment, and assessment of reporting bias, subgroups and sensitivity analyses

The assessment of risk of bias was conducted independently by two review authors (M.K.A., B.A.) using respectively ROBINS-I [18] for non-RCTs and Cochrane Collaborators Tool for RCTs [19].

Studies with more than moderate risk of bias were included for analysis because there is no consensus on whether systematic reviews should routinely include studies with high risk of bias, especially when studies of high quality are not available [20].

Because the number of included studies for any single comparison was small (<10), it was not possible to assess the reporting or publication bias. Similarly, subgrouping and sensitivity analyses were not possible.

RESULTS

Included studies

As shown in Figure 1, out of a total of 10,057 articles identified through database searching, 1467 were excluded for being duplicates. Following title and abstract screening of the 8590 articles, 35 were eligible for full-text screening. Of these, 16 met all inclusion criteria, including nine RCTs and seven non-randomized studies.

Of the nine RCTs [21–29], one each was conducted in Brazil [21], Iran [22], Thailand [23], Argentina [24] and Malaysia [28], three from China [25–27], and one was conducted in both India and Brazil [29] (see Table 1). Three of the RCTs focused on blood donor recruitment [24, 25, 29], with the remaining six focused on retention of experienced and first-time blood donors [21–24, 27, 28].

Of the seven studies that did not involve RCTs [30–36], one each was conducted in Turkey [30], India [31], Iran [32], Malaysia [35] and Mexico [36], and two were conducted in Ghana [33, 34]. Among the seven studies, four were targeted at both new and existing blood donors [30, 33–35], and three were focused exclusively on retention of existing donors [31, 32, 36].

TABLE 1 Summary of randomized controlled trials on communication interventions for promoting blood donations in low- and middle-income countries.

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time frame for follow-up	Results
Pongsananurak et al. [21]	Thailand	Retention of first-time blood donors	First-time blood donors	RCT	Blood centre	2667 at baseline; 2379 at endline	Text messages Message content: 'We would like to inform you that your blood has been used for patients today, DD/MM/YYYY. Because of your blood donation, patients' lives will be saved'.	Telephone	No	No	Actual donation Within 9 months after the first donation of the first-time blood donors	The incidence rate was 22.4 and 16.9 per 100 donor-years in the text group and the control group, respectively with the incidence rate ratio of 1.31 (95% CI, 1.06–1.63; $p = 0.005$) and significantly increased retuning rate (hazard ratio, 1.31; 95% CI, 1.03–1.68; $p = 0.03$)- in the text group compared with the control group.
Hashemi et al. [22]	Iran	To retain first-time blood donors	First-time blood donors	RCT	Four blood centres	1356 at baseline; attrition = 394	(1) Reminder phone calls with a focus on the ability to donate again and inviting them to refer to the nearest blood collection site; (2) an educational letter with general information about the patients' needs for transfusion and about components processed being delivered to hospitals; (3) an emotional letter about blood donation containing a true story about a patient who had been saved by blood transfusion; (4) motivational 1-h meeting containing a presentation on the importance of blood donation and patients' needs for transfusion immediately after donation, and being informed 3 months later that they can donate again	Letters, meetings, phone	No	No	Donation attempt Seven months after first donation	A total of 394 (29%; 95% CI, 0.26–0.31) first-time blood donors made the second donation within 6 months with emotional letter having 36% (95% CI, 0.31–0.42; $p = 0.001$) and being the most effective intervention. Blood door return rate in the control group was 22.1% (95% CI, 0.17–0.27).
Lucena et al. [23]	Brazil	To retain first-time, sporadic and loyal blood donors	First-time donors	RCT	One private blood bank in Brazil	1188 (attrition not reported)	Type: WhatsApp messages Messages focused on appreciation, altruism, the donated blood having been used, reminders for new donation and motivation	Mobile phone	Social marketing	No	Donation attempt Five months after first donation (one month after the last message was sent in fourth month of the intervention)	There was no significant difference ($p = 0.603$ with p-value of 5%) in the return rate with 18.73% return rate in the intervention group and 19.64% in the control group.

TABLE 1 (Continued)

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time frame for follow-up	Results
Iajya et al. [24]	Argentina	To recruit voluntary blood donors	General population	RCT	Blood banks in a metro area	18,500 subjects were randomized into seven arms.	T1: Invitation + Information Social recognition: Newspaper mention Messaging Flyer: T0 (Baseline: Invitation only): Individuals received a flyer inviting them to make an undirected, voluntary blood donation within three weeks. 'T1 (Information only): T0+ the flyer indicated the importance of voluntary blood donations rather than emergency/replacement donations'. T2 (T-shirt): T1+ the flyer showed that if they presented at the blood bank within three weeks, recipients would receive a t-shirt to show that they are blood donors. T3 (Newspaper mention): T1+ the flyer indicated that if they presented at the blood bank within three weeks, their generous act of voluntary blood donation would be recognized in the local newspaper T4, T5, T6 (Supermarket vouchers): T1+ the flyer showed that if they presented at the blood bank within three weeks they would receive a coupon	Use of flyers for inviting people to donate blood; use of newspapers as incentive for blood donation	No	No	Donation attempt Actual donation Donation attempt and actual blood donation within three weeks of receiving messaging	No effect of information or social recognition on turnout or usable units was found among the groups with different conditions (control condition, the information only condition, the t-shirt condition or the newspaper name mention condition).

TABLE 1 (Continued)

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time frame for follow-up	Results
Ou-Yang et al. [25]	China	To recruit inactive donors	Inactive blood donors	RCT	Blood centre	2074; attrition not reported	Phone call and text messages. Phone call: Donors were asked questions about reasons for not re-donating, and were asked whether and when they will re-donate in the future. Text messages: 'Dear Donors, thank you for your donation, which brought hope to patients. Please give blood again to save lives if you are available. Thank you for your support'	Mobile phone	No	No	Actual donation Repeat donation over a 7-month period	Statistically significantly different ($p = 0.044$) re-donation rates were found among the three groups (phone call group, message group and control with only significant difference (4.8% vs. 1.8%, $p = 0.017$; 7.3% vs. 1.8%, $p < 0.001$) between the phone call group and control group in paired comparison.
Ou-Yang et al. [26]	China	To retain first-time blood donors (Rh-negative) in an emergency situation	First-time Rh-negative blood donors	RCT	Hospital with 12 wards	1188; attrition not reported	SMS messages in three different forms: (1) Gain-framed: saving lives (2) Loss-framed: avoiding loss of lives (3) Information messages: low blood products	Mobile phones	Prospect theory	No	Actual donation Blood donors whose last donations were between 1 January 2015 and 31 December 2017 were given text messages (intervention) and no text messages (control) and followed for up to 2 weeks	The re-donation rate over time was significantly ($p = 0.034$) higher in the Rh-D-negative blood donors (RDNBDs) who received the loss-framed message than the group who received gain-framed message.
Hu et al. [27]	China	To recruit repeat donors among non-regular donors	Non-regular voluntary blood donors	RCT	Provincial blood management centre	751 (attrition not reported)	Web-based videos using WeChat and use of SMS text messages The length of the videos ranged from 45 s to 2 min • Allocation of Web-based video: 344 • Allocation of SMS: 407 Messaging: Weekly short videos based on the constructs of the extended theory of planned behaviour Timely responses from blood donor questions	Mobile phone	Extended theory of planned behaviour	No	Actual donation During the 3-month intervention period, or the first 3 months, and the next 3 months after the intervention ended	Statistically significant higher repeat rate by the intervention group than the control group (16.14% vs. 5.16%; $p < 0.001$) was reported. Repeat donation among men in the web-based group was 78% and the SMS group (control) was 62% (<0.001) but among women this was not statistically significant (22% in web-based group and 38% in the SMS group; $p = 0.24$). Blood donation of 2 times was significantly higher in the web-based group than in the SMS group (36.4% vs. 13.5%, $p = 0.004$).

(Continues)

TABLE 1 (Continued)

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time frame for follow-up	Results
Hasan et al. [28]	Malaysia	To recruit return donors	Deferred donors with low haemoglobin levels	RCT	National blood centre	382 participants	Mobile application-based educational tool • Allocation of intervention: 191 • Allocation of Control: 191 Mobile app messaging: anaemia education, iron education, and a list of iron-rich foods	Mobile phone	No	No	Actual donation Donation attempt Within 7-month of follow-up	The return rate was significantly higher in the mobile app group (81.2%) than in the control group (66.0%) ($p = 0.001$).
Harrel et al. [29]	Brazil, India	To increase overall blood donation	General population	RCT (staggered difference in differences)	Blood banks	47,000 facility based donation observations	Facebook blood donation tool	Mobile phone	No	No	Actual donation Within 365 days of rolling out the Facebook app	In Brazil and India an increase of blood donations from 0% to 14.1% (95% CI: 12.1%–16.2%) in the first year influenced by Facebook tool was reported.

Abbreviations: CI, confidence interval; N/A, not available; RCT, randomized controlled trial; SMS, short message services.

Effects of mass media and related interventions

Two studies conducted in Ghana examined the impact of a radio campaign on blood donor recruitment and retention. One assessed the impact of a partnership involving a radio station and a teaching hospital blood bank from 2003 to 2006 [33]. A related study that tracked blood donation from 2002 to 2008 found that the percentage of blood donations associated with radio station blood drives increased from 10% to 27%, whereas school-related donations remained relatively constant at 60% [34].

An RCT conducted in Argentina evaluated the use of name recognition in newspapers as an incentive for recruiting voluntary blood donors. In this study [24], respondents who were largely non-blood donors were informed that if they presented to donate blood voluntarily at a central blood bank within 3 weeks of receiving the information, then they would be recognized by name in a local newspaper ('La Gaceta'). None of the recipients of the information nor any of the participants in the control condition turned up to donate blood.

An observational study conducted in Turkey used television advertisements and other communication approaches, including in-person meetings, brochures and posters, to promote blood donor recruitment in a university and city dwellers outside the university. Within the university setting of 8730 students, 75% were eligible to donate blood and 66% attempted to do so [30]. Within the non-university setting of the 20,884 informed city dwellers, 87% were eligible to donate blood and 29% attempted to do so [30].

In Mexico, a number of strategies, including awareness raising using mail, posters and in-person communication, were implemented to encourage blood donation during COVID-19 from voluntary non-remunerated donors and family-replacement donors. Although a significant positive relationship was observed between the number of strategies implemented and the percentage of volunteer donors recruited ($\rho = 0.846$, $p = 0.002$) in 2019 and 2020, there was no significant relationship observed among family-replacement donors [36].

Effects of social media interventions on blood donation

Of the 16 eligible studies, 3 used social media as a platform to promote blood donation. A Brazilian study assessed the efficacy of text messages delivered via WhatsApp in motivating first-time and sporadic blood donors to become regular, repeat donors, but no difference was observed in return rates between those who received the WhatsApp text messages and control group participants who did not [23]. In another study, a Facebook tool used to enhance donor recruitment in Brazil and India [29] reportedly increased blood donations from 0% to 14.1% (95% confidence interval [CI]: 12.1%–16.2%) in the first year of the tool's use. In China, a web-based video was disseminated via WeChat to recruit non-regular donors and was found to increase repeat donation rate by 6.14%, as compared with 5.16% for a standard recruitment text message ($p < 0.001$) [27]. In Malaysia, Facebook was used to promote live broadcast of a song during World

Blood Donor Day celebrations, and the authors reported that the intervention was associated with an increase in blood donations to 2419 from 2110 in the month prior to the song's release [35].

Effects of mobile phone-based interventions excluding social media on blood donation

Of the 16 eligible studies, interventions delivered via mobile phone were the most common. Mobile text messages were used alone in studies conducted in Thailand [21] and China [26], and in combination with phone calls [25], and other interventions such as meetings, brochures and television [29]. Pongsananurak et al. [21] found that return rate among first-time blood donors randomized to a text group was significantly higher than the rate observed in a non-text control group (hazard ratio, 1.31; 95% CI, 1.03–1.68; $p = 0.03$).

Ou-Yang et al. [25] compared blood donation rates among first-time donors assigned to either a telephone call, text messages or control and found a significant difference only between telephone call recipients and controls. There was no significant difference between the text message group, and between phone call group and the text message group.

Ou-Yang et al. [26] assessed the effect of gain-framed or loss-framed text messages on the re-donation rate of previous Rh-D-negative blood donors and found that text messages with loss frames (such as donating blood to prevent loss of lives) were more effective than gained-framed messages (such as donating blood to save lives) ($p = 0.034$). Hashemi et al. assessed the efficacy of phone call reminders and other interventions on the return rate of first-time blood donors for a second donation within 6 months, and found that phone call reminders and the other interventions, including educational letters, incentives and meeting groups, were effective [22].

The efficacy of text messages in promoting return of blood donors in university and non-university groups was tested in Turkey [30]. The study found that of the 1403 voluntary blood donors in the university group, 582 returned to donate blood after receiving text messages while 870 attempted to donate blood without receiving text messages. However, compared with the non-university group, the donation rate after text requests was also significantly higher in the university group (12% vs. 8%; $p < 0.001$). The study asked repeat blood donors from the university and outside the university (city dwellers) to assess whether they received text messages on blood donation.

In Malaysia [28], a mobile application-based educational tool was used to recruit deferred donors with low haemoglobin levels, and it was observed that the return rate was significantly higher in the mobile app group (81.2%) as compared with a control group (66.0%) ($p = 0.001$).

Drama or entertainment-based interventions

The only study to use an entertainment approach was a Malaysian study [35], which used Facebook to promote live broadcast of a song during World Blood Donor Day celebrations.

Outcome measures

Of the nine RCTs, two used only blood donation attempt as outcome measures [22, 24], six used actual donation [21, 27–29], and one assessed both donation attempt and actual donation [24]. Among the seven non-RCTs, one used both donation attempt and successful donation [30], and the other six used actual blood donation [31–36].

Use of theories and implementation science frameworks

Three of the 16 studies (all RCTs) explicitly mentioned that they were informed by socio-behavioural science theories, including social marketing [23], prospect theory [26] and an extended theory of planned behaviour [27]. None of the nine RCTs or seven non-RCTs used implementation science frameworks to address the translation and integration of efficacious and effective approaches into real-world practice (Table 2).

Funding sources and conflict of interest information

Funding information was reported for seven of the nine RCTs [21–27] and two of the seven non-RCTs [35, 36], with all the seven RCTs citing non-profit sources of funding, and the two non-RCTs reporting no funding. Of the 16 studies, only 2—both no-RCTs—reported no funding [35, 36]. Declaration of either conflict or no conflict of interest information was available for seven of the nine RCTs [21–23, 25–29] and three of the seven non-RCTs [30, 35, 36]. None of the RCTs was funded through non-profit sources. Although a study that focused on the use of Facebook for promoting blood donation had a co-author working for Facebook Inc. [29], no funding or conflict of interest information was reported (see Appendix S1 for details).

Risk of bias

Of the nine RCTs, four had a low risk of bias [24, 26–28], three had some concerns [22, 25, 26] and two had serious concerns [30, 31, 33–36]. Of the seven non-RCT papers, six had a critical risk of bias and one had a moderate risk of bias [32] (see Appendix S1 for details).

DISCUSSION

This systematic review identified nine RCTs and seven non-RCTs studies on the effectiveness of communication interventions for aiding blood donation. It was surprising that no RCT was conducted in SSA despite earlier reviews calling for increased efforts in LMICs [8, 9]. Surprisingly, despite the initiative for blood donors to donate at least 25 times by the time they are 25 years old (known as Club 25) being commonly practiced in SSA [37], none of the studies assessed

TABLE 2 Summary of non-randomized studies on communication interventions for promoting blood donations in low- and middle-income countries.

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time for follow-up	Results
Eser et al. [30]	Turkey	To recruit new blood donors. To retain blood donors	University students; outside university residents	Before and after study, with no control	University and community settings	29,614 people were reached	Recruitment: Two experienced blood reached volunteers effectively; public announcements via television, the internet, brochures and posters; retention: SMS to volunteers who donated blood once a year for donation Messaging: Importance of blood donation and the safety of blood donation	Recruitment: Mass media (television, brochures, posters and internet), face-to-face retention: SMS	No	No	Donation attempt Actual donation Follow-up period was between November 2006 and August 2008. For repeat donation, follow-up period was 1 year.	After educational campaigns, the rates of admission for blood donation with a total of 29,614 people were 66% and 29% among university students and city residents respectively with statistically significantly (*p* < 0.001) higher application rate among the student group than non-student group. Repeat donation among university students was 32% and that of the group outside the university was 11%. The donation rate after the donors received SMS was significantly higher in the university group than the non-university group (12% vs. 8%; *p* < 0.001).
Agrawal and Tiwari [31]	India	To retain first-time blood donors	First-time blood donors	Before and after study, with historic control	Standalone blood bank	N/A	First 4 months: No tele-recruiter, then for 2 months two tele-recruiter and for next 6 months three tele-recruiter Messaging: Addressed grievances of first-time blood donors Requesting first-time donors to donate again Birthday and anniversary wishes	Mobile phone	No	No	Actual donation Within 8-month period.	With the 2091 tele-recruited donors, the average number of donation was found proportional to the number of tele-recruiters with 280 donations before tele-recruitment, 348 donations with 2 tele-recruiters, and 440 with 3 tele-recruiters, showing that tele-recruitment converts 'first-time' donors into repeat/regular donors.

TABLE 2 (Continued)

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time for follow-up	Results
Behnampour et al. [32]	Iran	To retain repeat blood donation	Repeat blood donors	Before and after study	Blood bank setting	170 subjects	In-person meetings; educational pamphlets and posters containing images and messages about participation in continual blood donation; a video clip shown in virtual groups Messaging: Focused on the culture of repeat blood donation	In-person meetings; pamphlets, posters containing; a video clip; posters; banners	Theory of planned behaviour; Social marketing	No	Actual donation One month and three months post-intervention	Significant increase of consistent blood donors and increase in blood donation with several statistically significant associated factors including bachelor level education with odds ratio 0.28 (95% CI, 0.08–0.94; $p = 0.04$), marital status 0.21 (95% CI, 0.60–0.76; $P = 0.01$), awareness 1.35 (95% CI, 1.04–1.75; $p = 0.02$) was found.
Allain et al. [33]	Ghana	To attract first-time blood donors and repeat donors	General population	Before and after study, with no control	Radio station	N/A	Radio station advertises blood donation; high profile parishioners such as singers, storytellers and stage actors to provide entertainment; music, stories donor or staff interviews to entertain the audience unless professional entertainers are available to deliver their performances; T-shirts provided Messaging: Educational talks and messages to motivate prospective and existing donors and to donate regularly	Radio station	No	No	Actual donation Each year, blood donation sessions were held in April or May, August or September, and December, and actual donations were assessed from April 2003 to December 2006	Out of a total 3801 donors who attended the radio programme, 92% potential donors were FM donors, with 85.5% and 70.3%, respectively volunteer and replacement donor with overall 1350 actual donations of which 39.3% by first-time donors and 60.7% by repeat donors.
Owusu Ofori et al. [34]	Ghana	To recruit new blood donors, and retain repeat blood donors	New blood donors Repeat blood donors	Before and after study	Radio stations, Schools, places of worship	N/A	In-person communication, partnership with five radio stations Messaging: Educational talks and messages to motivate prospective and existing donors and to donate regularly and make it a life-time commitment	In-person talks at schools and places of worship, talks using radio stations partnership with five radio stations	No	No	Actual donation Units of blood were assessed annually over a 7-year period from 2002 to 2008	Blood units collected from voluntary blood donors was 20.1% of the total collected from 2002 to 2008. In-person communication contributed to 62.9%, 6.5% and 5.2% of total units collected over the period in schools, churches and mosques respectively. Blood donation units collected from 2002 to 2008 were 9100 at the

(Continues)

TABLE 2 (Continued)

Authors	Country	Study objective	Population	Study design	Study setting	Sample	Type of communication intervention and messaging	Mode of delivery	Theory used	Implementation science framework	Outcome measures and time for follow-up	Results
												radio stations (with repeat donation being 57%), 27,544 at schools (with repeat donations being 18%), 2954 at churches (with repeat donations being 25%) and 2382 at mosques (with repeat donations being 32%).
Pei et al. [35]	Malaysia	To increase overall donation	General population	Before and after	Hospital	N/A	World Blood Donor Day (WBDD) Campaign • Live broadcast of song by Facebook and FM radio Messaging: Song emphasized the importance of regular and voluntary blood donation to maintain the balance between demand and supply	Social media using phone	No	No	Actual donation One month after playing the song	The number of donations before the month before the song was released, increased from 2110 to 2419 donations in the month after the song's release.
Peña-Carillo [36]	Mexico	To recruit altruistic and family donors	Repeat altruistic and family donors	Before and after study	Hospital	12,385 participants	*Altruistic interventions:* • +Donation campaign directed to staff or blooders or • Localization of family intervention • Awareness raising and promotion in donors Use of mail and posters Messaging: Information was provided on the requirements and need for blood donation during the pandemic; encouraged active participation in blood donation	Phone, in-person communication and posters	No	No	Actual donation Data collection occurred during the months of the implementation depending on the priority population: March to October 2020 (family donors), April to May 2020 (altruistic donors from blood bank employees), May to December 2020 (altruistic donors from the association of blood donors called Blooders) The 2020 data were compared with that of 2019	Statistically significant increase of altruistic donors in both 2019 and 2020 were found. A positive correlation was found between the number of strategies and the percentage of altruistic donors ($p = 0.846$, $p = 0.002$). No statistically significant differences among the family donors for 2019 and 2020 were found.

Abbreviations: CI, confidence interval; N/A, not available; SMS, short message services.

how this initiative is aiding blood donation in the region. Moreover, only one RCT aimed to recruit new blood donors. This is consistent with previous reviews that identified more RCTs focusing on first-time or repeat blood donors [8, 9]. However, of the seven non-RCTs studies, two were conducted in SSA. This finding suggests that previous reviews focusing only on RCTs might have missed some relevant papers in LMICs. With no RCT from a low-income country, and Argentina, Brazil and China being upper middle-income countries, and having five of the nine RCTs, the results show that RCTs were largely lacking in countries with low-income and lower middle-income economies.

Of the 16 studies, only 4 had a low risk of bias, indicating the need for more rigorous blood donation RCTs in LMICs. Moreover, the quality of the studies also reflected in how funding and conflict of interest information was presented. Given the low quality of the non-RCTs, it was not surprising that only two had funding information [35, 36], and only three had conflict of interest information [30, 35, 36].

Of the papers with low risk of bias, the one by Ou-Yang et al. [25] stands out in terms of being based on theory, and how the study was performed. In this study, Ou-Yang et al. used prospect theory to test the effect of gain-framed or loss-framed text messages on return of first-time blood donors who were Rh-D-negative. Notable strengths of the study included a novel focus on a specific subtype of whole blood donor, and the use of a text message intervention that was carefully designed to address a specific empirical comparison guided by a well-established theory. One potential limitation, however, is that the manuscript was unclear whether the messages had been pilot-tested on a separate sample to ensure efficacy. Another low bias study that featured a creative use of mass media was an Argentinian study by Iajya et al. [24], which used public recognition in a local newspaper as a potential incentive for recruiting new blood donors. Although the results of the study did not support the hypothesis in this instance, the approach should nonetheless be considered with other forms of mass media (e.g., radio, social media) and in other LMICs given other evidence that name recognition may help attract new blood donors and retain existing donors. For example, two cross-sectional studies conducted in Nigeria found that publishing the names of blood donors in newspapers could motivate people to donate blood [38, 39]. There is also a theoretical reason to persist with further testing of such approaches, as existing evidence from application of the Theory of Planned Behaviour to the blood donation context makes it clear that many blood donors are motivated by subjective norms or perceived social pressure to engage in blood donation behaviour [40, 41]. Thus, while a single media campaign may not result in an immediate effect on donation behaviour within a population, over time the growing recognition that others are engaging in this public good may help to build a subjective norm within community members in support of the behaviour.

Few studies have used social media tools to promote blood donation in LMICs; however, this area of research remains in its infancy despite the ubiquity of public engagement with social media platforms. Early indications of the potential for social media to enhanced donation behaviour in LMIC populations has been mixed, including evidence of increased donations in Brazil when a Facebook recruitment campaign was implemented [35]. However, no change in donor retention rates was found when WhatsApp messaging was used to retain blood donors [21]. The existing studies are few in number and insufficiently rigorous to draw firm conclusions. Importantly, the design of future communication intervention studies should also be informed by theoretical models that have previously been shown to predict donor behaviour [42], with the goal of targeting and measuring key motivational constructs. These studies are desperately needed to generate the evidence base that policymakers and transfusion professionals require to make informed decisions about which communication approaches are most likely to translate into improved donation rates. Relatedly, it is concerning that of the 16 studies reviewed, none cited the use of any implementation science framework to guide the design, implementation or evaluation of the communication interventions. Without applying implementation science frameworks, factors that could help national blood services in LMICs to design and implement successful communication interventions for increasing blood donation are lacking.

Given the lack of adequate studies on communication interventions for promoting blood donation in LMICs, particularly in SSA, there is a need to build communication research capacity in transfusion services across the continent. Such capacity building efforts should include the use of relevant implementation science frameworks and socio-behavioural science theories to ensure that findings generated are evidence-based and can be implemented in an effective and sustainable manner.

Finally, we acknowledge that a limitation of the present review is that we uncovered relatively few studies on communication interventions designed to promote blood donation in LMICs, hence we were unable to apply meta-analytic methods. In addition, because some of the studies applied multiple communication approaches as a single intervention, in these cases, we were unable to attribute observed outcomes to specific intervention components. Also, limiting eligibility to studies published in only English might have led to missing relevant studies published in other languages.

In conclusion, to our knowledge, this study is the first to systematically review the efficacy of communication interventions to promote blood donation in LMICs. However, the efficacy of communication interventions for promoting blood donations in LMICs remains limited due to few rigorous studies identified in this systematic review, which limited the ability to apply meta-analytic methods. More communication interventions that use socio-behavioural theories and implementation science frameworks are urgently needed in LMICs to help improve blood supply.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data supporting the results of this study are available within the article and its Supporting Information S1.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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