A systematic review of strategies to increase access to health services among children over five in low and middle income countries

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Abstract

Background

The populations of many low and middle-income countries (LMIC) are young. Despite progress made towards achieving Universal Health Coverage and remarkable health gains, evidence suggests that many children in LMIC are still not accessing needed health care services. Delayed or lack of access to health services can lead to a worsening of health, and can in turn negatively impact a child's ability to attend school, and future employment opportunities.

Methods

We conducted a systematic review to assess the effectiveness of interventions aimed at increasing access to health services for children over five years in LMIC settings. Four electronic databases were searched in March 2017. Studies were included if they evaluated interventions that aimed to increase: health care utilisation; immunisation uptake; and compliance with medication/referral. Randomised controlled trials and non-randomised study designs were included in the review. Data extraction included: study characteristics, intervention

type, and measures of access to health services for children over five. Studies outcomes classified as positive, negative, mixed or null in terms of their impact on access outcomes.

Results

Ten studies met the criteria for inclusion in the review. Interventions were evaluated in Nicaragua (1), Brazil (1), Turkey (1), India (1), China (1), Uganda (1), Ghana (1), Nigeria (1), South Africa (1), and Swaziland (1). Intervention types included education (2), incentives (1), outreach (1), SMS/phone call reminders (2), and multicomponent interventions (4). All evaluations reported positive findings on measured health access outcomes, however the quality and strength of evidence was mixed.

Conclusion

This review provides evidence of the range of interventions that were used to increase health care access for children over five years old in LMIC. Nevertheless, further research is needed to examine each of the identified intervention types and the influence of contextual factors, with robust study designs. There is also a need to assess the cost-effectiveness of the interventions in order to inform decision makers on which are suitable for scale-up in their particular contexts.

Systematic review registration

PROSPERO CRD420160334200

Keywords

Access, health care, children, adolescents, low and middle income country, universal health coverage

Background

The problem, condition, or issue

Despite global ageing, populations of many low and middle-income countries (LMIC) are young and this population structure is likely to remain for the next several decades.(1-3) Over 40% of the population in Africa are under 15 years and young people aged 15-24 years account for a further 19%.(2) Health and wellbeing in childhood has defining effects on future health and socioeconomic outcomes.(4) This is recognised in global health strategies such as the 2010 Millennium Development Goals (MDGs) and the more recent Sustainable Development Goals (SDGs) through their strong focus on improving child health.(5, 6) As a result, there have been substantial gains in child health in recent years. Globally, under-five mortality has declined by more than half from 90 to 43 deaths per 1000 live over the period 1990-2013.(5) Thus, an increasing number of children are surviving beyond five years of age into older childhood and adolescence. However, children over five years have received much less attention in global health strategies, which may have contributed to the slow progress in health gains compared to children under five.(7)

Universal Health Coverage (UHC), highlighted in the SDGs, is an area of increasing interest globally. It is defined as “ensuring that all people have access to needed promotive, preventive, curative and rehabilitative health services, of sufficient quality to be effective, while also ensuring that people do not suffer financial hardship”. Improving access to health for all children is vital to realising the SDGs and achieving UHC. Despite substantial progress towards achieving UHC, evidence suggests that children in LMIC are not accessing vital health care services.(8, 9) Lack of access to health services can lead to poorer health and can in turn negatively impact school attendance, social relationships, quality of life and employment

opportunities later in life.(10) This review focuses on strategies to improve access to health for children over five in LMIC where there is a substantial need.

Whilst previous research has explored barriers to accessing health care services in LMIC, there is limied evidence for the effectiveness of interventions to overcome these barriers and increase access to health care for children over five.(11) Previous systematic reviews have been conducted on access to health for children in LMIC, however these have focussed on children under five years. These have included: interventions to improve immunisation uptake (12), and the impact of cash-transfers on service utilisation (13). Further, we conducted a separate review on interventions to improve access to health services for children under five in LMIC.(14) Several previous reviews have explored evidence for interventions to address specific health needs for adolescents (aged 10-19 years) such as preventing unintended pregnancies (15), increasing physical activity (16), prevention of HIV (17, 18), smoking cessation (19, 20), and improving contraceptive use (21, 22). Whilst most previous reviews have focussed on individual health outcomes related to specific health needs, few reviews have focussed on outcomes related to health service access for older children in LMIC. A review by Dick et al (2006) on interventions to increase young people's (aged 10-24 years) use of health services in LMIC concluded that there was sufficient evidence to support widespread implementation of interventions that include training of service providers, facility improvement, and informing and mobilising communities.(23) Updated evidence is required on a broader age group to include all children over five years.

Identifying interventions that aim to increase health care access for children over five and understanding their effectiveness is important for informing decision making and implementation of appropriate evidence-based interventions.(13, 24-27) In light of the lack of research, we conducted a systematic review of interventions to increase access to health services among children over five in LMIC. The specific objectives were to:

- Identify and describe the different strategies used to increase access to health care services for children over five
- Evaluate the effectiveness of strategies used to increase access to health care services for children over five

Methods

The systematic review was conducted based on guidance from the Cochrane handbook and reported according to the the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement.(28)

We conducted a separate review in parallel that focussed on interventions to increase uptake of services for children under five years of age.(14) Thus, a detailed methodology and search strategy has been published previously.(14) In brief, four databases (EMBASE, Global Health, MEDLINE, and PsychINFO) were searched in March 2017. The search strategy is provided as Appendix 1. Titles, abstracts, and full texts were double screened. The study inclusion and exclusion criteria using the PICO method (Participant, Intervention, Comparison, and Outcomes) is summarised as follows.

Inclusion and exclusion criteria

Participants

Studies were included if children over five or their caregivers were the main recipient of the intervention. This age group is broad, encompassing young children aged 5-9 and adolescents (>10 years), and thus have diverse health needs. For instance, sexual and reproductive health forms an important need is an important need for adolescents, but not younger children. Further, varying levels of school attendance amongst this broad age group is an important

consideration for school-based interventions. We did not attempt to restrict the search by smaller sub-categories (e.g. adolescents) in order to capture as many studies as possible for all children over five. Where possible, results were disaggregated by age categories. Where a proportion of the beneficiaries were aged <5 years or >18 years, studies were included provided that access outcomes were measured in children aged over five. If the main recipient was the caregiver, the measured outcome had to be related to the child (e.g. immunisation status). We focussed on this age group because they have previously been neglected from research and global health strategies. As a result there has not been substantial health gains in this group in comparison to those under five. In addition, children over five years have different health needs to those under five. Understanding how to improve access to health services for this group is important for achieving UHC.

Intervention types

Intervention that were eligible included those that aimed to increase access to health services for children over five, both on the supply and demand side. Access to health care was defined as the receipt of health care by those with the potential to benefit, and included health promotion, disease prevention, diagnosis, care for episodic and chronic illness, and rehabilitation services.[4]

Comparison

To be eligible, studies must have included comparison group in order to understand the effect of the intervention. Studies that compared to standard care, or a simplified version of the intervention were considered for inclusion. Controlled before and after studies with one group of children were also considered eligible.

Outcome types

Based on the definition of access we used above, studies that measured the following outcomes were included: health care utilisation (e.g. sexually transmitted infection management service use), immunisation uptake (e.g. e.g. coverage of Hepatitis A vaccination) , and compliance with medication/referrals (e.g. adherence to antiretroviral therapy (ART)) were considered eligible for inclusion.

Types of study

Randomised controlled trials (RCTs), and non randomised controlled studies (NRS) such as controlled before and after studies were eligible for inclusion in the review. We used the Cochrane Handbook to define study types.

Procotol and registration

The study protocol is registered with PROSPERO International prospective register of systematic reviews (registration number: CRD420160334200).

Data extraction and analysis

Data was first extracted by TB and then checked by SP independently. Details on the publication, methods, study location, study participants, interventions, outcomes measured and results were extracted.

In order to summarise the effectiveness of the interventions, results were classified as “positive” if there was a statistically significant improvement in the outcome(s) of interest in the intervention group compared to a control (or comparison) group. If a statistically significant decrease in the outcome(s) relative to the comparison group were classified as “negative”. If no

statistically significant change was seen, studies were classified as “null”. Studies measuring multiple outcomes were classified as “mixed positive” if there was a significant improvement in one outcome and no significant change in other outcomes and “mixed negative” if findings were a mix of negative and null.

To synthesise results, a narrative approach was used, in line with the recommendations for systematic reviews of complex interventions.(29) A meta-analysis was not conducted due to the variation in included study designs, intervention types and outcomes.

Quality of included studies

The methodological quality was assessed independently by two authors (TB, SP). Any discrepancies in judgements were resolved through discussion. Each study was scored as weak, moderate, or strong quality using the Effective Public Health Practice Project (EPHPP) assessment tool for quantitative studies.(30) In addition, we measured process indicators including: fidelity, dose, reach, context according to Saunders et al. (2005).(31)

Results

Study selection

After duplicates were removed, 9994 studies were screened based on title and abstract. Full-texts were examined for 164 studies, of which 154 were excluded. Reasons for exclusion included: inappropriate study design, outcomes related to access not measured, and participants were only children under 5. This yielded 10 relevant studies for inclusion in the review. This process is detailed in Figure 1.

Description of studies

Study characteristics

The majority of studies were conducted in urban or peri-urban settings (six studies) in sub-Saharan Africa (five studies) or Latin America (two studies). Most studies were published after 2010 (eight studies). In terms of study design, the majority were RCTs or cluster RCTs (seven studies).

Studies evaluated interventions that targeted three broad groups of health topics: sexual and reproductive health (six studies), communicable diseases (three studies), and non-communicable diseases (one study). In terms of outcomes, the majority of studies measured health care utilisation (six studies) (32-37), whilst three studies measured compliance to treatment (38-40), and one study measured immunisation uptake (41).

Table 1: Characteristics of included studies

Variable	Number	%
Location		
Urban or peri-urban	6	60
Mixed (urban and rural)	4	40
Decade of publication		
2000	2	20
2010	8	80
Study design		
RCT	7	70
Non-randomised trial	1	10
Controlled before-after study	1	10
Longitudinal study	1	10
Region		
Latin America/Caribbean	2	20
East Asia/Pacific	1	10
Sub-Saharan Africa	5	50
South Asia	1	10
Europe/Central Asia	1	10
Outcome category		
Immunisation	1	10
Health care utilisation	6	60

Compliance to treatment	3	30
Delivery mode		
School-based	3	30
Clinic based	3	30
Community	2	20
Combination	2	20
Health topic		
Sexual and reproductive health	6	60
Non communicable diseases	1	10
Communicable diseases	3	30

Participants

A total of 11,895 children were included in this review across the 10 studies (range 65-3754 children per study). The age of children varied across studies and included: 2-12 years (34), 7-16 years (40), 6-15 years (39), 10-14 years (38), 14-18 years (37), 12-20 years (36), 10-24 years (33), under 18 years (35), under 20 years (41), and 15-18 years (students in school grades 9 and 11) (32). Thus five studies in our review focussed on adolescents (aged >10 years), each of these focussing on sexual and reproductive health needs. The remaining five studies focussed on younger children or a children under 18 more broadly. These studies focussed on communicable diseases and non-communicable diseases, reflecting the different health needs in this group.

Intervention types

Interventions were categorised and compared in in terms of their approach to addressing access to health services. Intervention types included the following: education, incentives, outreach, SMS/Phone call reminders, and multi-component interventions. Table 2 provides an overview of the intervention types, by targeted disease and delivery location. Appendix 3 provides a more detailed table of relevant extracted data.

Table 2: Overview of intervention types of included studies

				Intervention components									
Author (year); location	**Study design and participants**	**Delivery mode**	**Intervention description**	Incentive	Education	Health worker training	Peer support	Community mobilisation	Outreach	SMS/Phone call reminders	**Outcome category**	**Measured outcome; and summary result**	**Quality**
Bhana (2014); South Africa	RCT; Children 10-14 years enrolled in HIV care; n=65	Clinic-based	SRH: Health/mental health education programme for HIV infected adolescents delivered by lay counsellor		✓						Compliance	Adherence to anti-retroviral treatment; positive effect	Weak
Burnett (2011); Swaziland	RCT; students in grades 9 and 11 at one school; n=135	School-based	SRH: Teacher delivered HIV education programme		✓						Health care utilisation	HIV testing uptake; positive effect	Strong
Kundu (2012); India	Longitudinal study; Children 2-12 years; n=100 (1st Year) n=80 (2nd year)	Community-based	SRH: Incentive scheme for attendance at HIV clinic	✓							Health care utilisation	HIV clinic attendance; positive effect	Moderate
Favre (2015); Brazil	RCT; Children aged 6-15 years; n=3,092	School-based	CD: Schistosomaisis treatment programme						✓		Compliance	Treatment and diagnosis coverage; mixed positive effect	Strong
Lin (2012); China	RCT; Children aged <18 years; n=258	Clinic-based	NCD: SMS appointment reminders for follow-up cataract appointments							✓	Health care utilisation	Appointment attendance for cataract; positive effect	Strong
Camurden (2015); Turkey	CBA; Children with diabetes under 20 years; n=231	Clinic-based	CD: Vaccination recommendation and phone call							✓	Immun-isation uptake	Vaccination uptake; mixed positive effect	Weak
Muhumuza (2014); Uganda	cRCT, Children 7-16 years; n=1,284	School-based	CD: Pre schistosomaisis treatment snack and education	✓	✓						Compliance	Treatment uptake; positive effect	Strong
Meuwissen (2006); Nicuragua	NRS; Poor female adolescent aged 12 to 20 years; N= 3,009	Community-based	SRH: Voucher for sexual and reproductive health and educational booklet	✓	✓						Health care utilisation	Sexual and reproductive health service utilisation; positive effect	Strong
Okonofua (2003); Nigeria	cRCT; In school adolescents 14-18 years; n=3754	School and clinic based	SRH: Peer education, teacher education, health worker training on sexual and reproductive health		✓	✓	✓				Health care utilisation	Treatment seeking behaviour for sexual and reproductive health; mixed positive effect	Weak
Aninyana (2015); Ghana	cRCT; Adolescents aged 10-24 years; n=2,664	School and community based	SRH: In school education, peer education for out of school adolescents, health worker training, community mobilisation		✓	✓	✓	✓			Health care utilisation	Sexual and reproductive health service usage; mixed positive effect	Weak

SRH=sexual and reproductive health; CD=communicable disease; NCD=non-communicable disease; CBA=controlled before after study; cRCT=(cluster) randomised controlled trial; NRS=non-randomised study

Comparison group

The majority of studies (6) compared the intervention to routine care (no intervention). In the remaining four studies, the comparison group received a simplified or reduced version of the intervention. Appendix 3 provides further details of the comparison groups.

Quality of included studies

Five of the 10 included studies were judged to be weak in quality due to lack of control for relevant confounders (four studies) (33, 37, 38, 41), lack of report of withdrawals or dropouts (one study) (41), study design (one study) (34), and selection bias (one study) (38). Appendix 2 provides details of the risk of bias assessment for each of the included studies.

Effectiveness of interventions

Education

Two studies evaluating child education alone to improve uptake of HIV testing uptake or antiretroviral (ARV) adherence were included in this review, both were RCTs conducted in sub-Saharan Africa on adolescents. Education was also included as one component of four multi-component interventions discussed below. In Swaziland, Burnett et al. (2011) evaluated the impact of a teacher delivered educational programme entitled “It’s Our Future Too” and reported HIV testing uptake at a single school. The curriculum included modules on: “relationships/assertive behaviour, HIV and sexually transmitted infection basics, prevention, treatment, and testing of HIV, stigma and discrimination, and living with HIV”. There was evidence to suggest that students from the intervention group were more likely to get a HIV test following the intervention compared to baseline ($p<0.001$). No change was found in the control group who received no intervention. However, as the study was conducted in one school, the sample size was small (n=135) and there was a possibility of contamination between the

intervention and comparison groups which may have weakened the effect size (n=135) (Appendix 2).

A South African pilot study conducted by Bhana et al. (2014) assessed the effect of a collaborative HIV prevention and adolescent mental health educational programme ("VUKA Family Programme") on adherence to ARVs. The intervention was delivered by a lay counsellor to children aged 10-14 years enrolled in HIV care and their families. It was delivered over 6 sessions over a 3-month period, and, used a cartoon storyline and curriculum that covered key topics including: AIDS related loss, HIV transmission and treatment, disclosure of HIV status, adherence to medical treatment, stigma and discrimination, and caregiver-child communication. Adherence to ARV therapy was found to be higher in the intervention group than the control group at follow-up ($p<0.05$). However, the strength of the evidence connecting the intervention to changes in adherence was considered weak due to due unclear reporting of allocation concealment, randomisation and blinding as well as a small sample size (n=65) (Appendix 2 and 3).

Incentives

One study, by Kundu et al (2012) evaluated the provision of supplementary nutrition as an incentive for HIV clinic attendance in India. Supplementary nutrition was provided as monthly take home rations for younger children aged 2-12 years attending an HIV/AIDS clinic. The study was clinic-based, longitudinal and measured outcome in the same group of individuals at baseline, and after intervention. Clinic adherence significantly improved compared to baseline (Odds Ratio (OR)=3.00 95% CI 1.27, 7.08) and mean annual number of clinic visits significantly increased ($p<0.001$). Children of migrant workers were excluded from the study, indicating the possibility of selection bias. This, alongside the small sample size (n=100), makes it difficult to

attribute changes in attendance to the intervention. Two other studies combined incentives with other components and are discussed below.

Outreach

One RCT by Favre et al. (2015) evaluated the impact of school-based outreach services on schistosomaisis diagnosis and treatment coverage in Brazil. Authors compared school-based diagnosis and treatment (outreach) to community-based treatment amongst children aged 6-15 years. No significant increase in treatment compliance at 12-month follow-up was found between the intervention and control groups. However, this study did find higher diagnosis coverage at baseline (Adjusted OR (aOR)=1.95 (1.64, 2.32)) and follow-up (aOR=1.87 (1.25,2.78)) in schools compared to community. Details were lacking on randomisation, allocation concealment and blinding in the methodology, weakening the strength of the evidence (Appendix 2).

SMS appointment reminders

Two included studies evaluated SMS or phone call reminders for improving healthcare uptake for children. Camurden et al. (2015) in Turkey evaluated the impact of a vaccination recommendation by a paediatrician to children under 20 with diabetes followed by two phone call reminders. The intervention group was compared to hospital controls who received routine care and one phone call reminder at the time of the second reminder for the intervention group. This study used a controlled before after study design. Authors found significant increases in vaccination status for Hepatitis A, Varicella, PCV13, PCV23 among those receiving the intervention ($p<0.001$). However, no significant changes were seen for Diptheria, Mumps, Measles, or Hepatitis B (mixed positive result). The study only reported post-intervention vaccination coverage in intervention group, making causal inferences difficult without adequate control. Further, the study was also judged to have a high risk of bias because the control

group, drawn from the hospital, was significantly different to the intervention group at baseline and no adjustments were made for potential confounders (Appendix 2).

Lin et al. (2012), evaluated the effect of SMS appointment reminders on attendance at follow-up appointments for pre and post-operative cataract patients aged <18 years in China in an RCT. Compared to controls who received no reminders, the number of follow-up appointments attended was significantly higher in the intervention group (Risk Ratio=1.47 (1.16, 1.78)). This study was judged as having high quality.

Multi-component interventions

Four of the 10 included studies used a combination of interventions aimed at improving access to health services for children over five, three in sub-Saharan Africa and one in Latin America.

Of these studies, two had a primary focus on education on sexual and reproductive health for adolescents. In Nigeria, Okonofua et al. (2003) evaluated a school-based package of reproductive health education on treatment seeking behaviour for adolescents aged 14-18 years through an RCT. This included the following: educational health clubs in schools for students to learn and talk about reproductive health problems, peer support, and training of sexually transmitted disease health providers. School students identified health providers they knew in the neighbourhood for sexually transmitted disease treatment, these providers were trained, and a list of trained private providers compiled for students. This effectively set up a link between schools and private providers. Four secondary schools received the intervention and eight control schools (two in intervention area, and two elsewhere) were also included. Following the intervention, there were no changes in treatment seeking for symptoms of sexually transmitted diseases at hospital/clinic or traditional healers. However, adolescents in the intervention schools were twice as likely to seek care at a private provider compared to controls schools (aOR=2.10 (1.10, 3.99)) (mixed positive result). The study lacked detail on method of

randomisation, and allocation concealment, and some baseline differences between intervention and control groups were not adjusted for in the analysis (Appendix 2).

In a similar cluster RCT conducted in Ghana, Aninyana et al. (2015) evaluated the impact of a combined intervention on service use for sexually transmitted infections in adolescents aged 10-24 years. The intervention included: school based sexual and reproductive health education using a variety of methods, peer education for out of school adolescents, health worker training in youth friendly health services, and community mobilisation. At endline evaluation (after three years), the study found a significant increase in Sexually Transmitted Infection (STI) management service usage (aOR=2.47 (1.78, 3.42)) and perinatal care service usage (aOR=1.89 (1.37, 2.60)) in the intervention group compared to controls, however no significant increase was seen in use of HIV testing and counselling (aOR=1.16 (0.85-1.58)) (mixed positive result). Details on blinding were lacking and there was a high proportion of withdrawals and dropouts in the intervention (24%) and comparison groups (28%). Further, stated *a priori* confounding factors did not appear to be controlled for in the analysis, weakening the strength of the evidence (Appendix 2).

Two studies evaluated multi-component interventions that had a primary focus on incentive programmes, one for adolescents and the other for children aged 7-16 years. The first, conducted in Nicaragua by Meuwissen et al. (2006), evaluated the effectiveness of vouchers for free sexual and reproductive care provided to low-income female adolescents aged 12-20 years in a quasi-experimental study. Vouchers were distributed in low-income neighbourhoods and outside schools. Providers were reimbursed based on the number of vouchers used. A cross sectional survey, conducted approximately 12 months after voucher distribution, found that those who received vouchers had significantly higher use of sexual reproductive health care than those who did not (aOR=3.1 (2.5, 3.8)) (positive result). However, due to the quasi experimental nature of the study, attributing changes in utilisation over time to the vouchers may

not be appropriate without understanding what other programmes are on-going in the study area (Appendix 3).

Muhumuza et al. (2014) evaluated the impact of a school-based schistosomiasis programme in Uganda on treatment uptake using a cluster RCT design. Children aged 7-16 years in six schools received a pre-treatment snack and trained teachers delivered educational messages about schistosomiasis (intervention group), and another six schools (comparison group) received educational messages only. This study found a higher proportion of primary school children in the intervention group took up treatment than in the control group ($p<0.05$) (positive result). This study was judged as having high quality.

Process indicators

Appendix 4 provides an overview of the process indicators (fidelity, dose delivered, dose received, and context) reported by the included studies. In terms of fidelity (extent to which the intervention was implemented as planned), only the study by Favre et al (2015) which evaluated schistosomiasis treatment and diagnosis outreach reported fidelity indicators to an adequate level.(39) A further two reported some limited details.(35, 38) Dose delivered (completeness) was reported in five of the 10 studies.(32, 36, 38-40) Dose received (exposure) was reported adequately in only one study (38), and satisfaction with the programme in five studies (33, 35-38) Half of studies reported contextual factors that may influence the intervention implementation.(34, 35, 37, 39, 40)

Discussion

We conducted a comprehensive systematic review of peer-reviewed literature on interventions to increase access to health care with a specific focus on children over five years in LMIC. The review identified 10 peer-reviewed studies, half of which were conducted in sub-Saharan Africa. In five studies, the main beneficiaries were adolescents, whilst in the remaining studies included

both younger children and adolescents. Studies focussed on three broad groups of health concerns: sexual and reproductive health (six studies), non-communicable diseases (one study), and communicable diseases (three studies). Intervention types varied across studies. Two studies focussed on education alone, two studies assessed the effectiveness of text-message or phone call reminders, one study tested incentives alone, and one study evaluated outreach services (Table 2, Appendix 3). Further, four studies evaluated multi-component interventions with either: a primary component of education (two studies) or a primary component of incentives (two studies). Interventions were delivered in three main settings: clinic (three studies), community (two studies), school (three studies), or a combination (two studies). Overall, all studies found a positive or mixed positive effect on measured health care access outcomes, however the strength of the evidence varied.

Education

Educational interventions aim to improve demand through addressing user's knowledge and attitudes about health and health services. Lack of knowledge has been identified as an important demand-side barrier to accessing health care in LMIC for both children and adults.(42) Educational interventions may have a role in addressing this barrier. Our review found that educational interventions in South Africa and Swaziland had a positive effect on uptake of HIV testing and ARV treatment. A further two studies in Nigeria and Ghana evaluated multi-component interventions with a primary focus on education, and found improved utilisation of sexual and reproductive health services. Despite these positive findings, the small number of studies and concerns about their quality limits generalisability. Our findings therefore support a previous review of interventions to improve utilisation to sexual and reproductive health services for young people (10-24 years) which concluded that while educational interventions for young people were promising, further evidence was needed.(43) Our review highlighted a significant

gap about educational interventions for children under 10 years, as most studies in this group focussed on adolescents.

The Ghanaian study, evaluating a multi-component intervention, was one of only two studies that explicitly included children who are not attending school; the other evaluated an incentive programme in Nicaragua. Given that over 25% of lower-secondary school children in LMIC are estimated to be out of school, and that poor health can contribute to school absenteeism, addressing the health needs of these individuals is vital.(44) Both studies including out-of-school children found positive results, suggesting that these types of interventions might be beneficial for this group. However, more research evidence is warranted given the limited number studies.

Community mobilisation was included as a component of the combined intervention in Ghana. No other interventions included in the review included this activity. Although the Ghana study found positive results, the multi-component nature of this intervention mean it is difficult to understand the contribution of community mobilisation to the improved utilisation of sexual and reproductive health service. The health of children is greatly influenced by factors at the personal, family and community level and addressing these wider determinants is an important consideration for future interventions.(45) Given the stigma surrounding HIV and sexual and reproductive health, family and community involvement is likely to be an important consideration for all interventions tackling these areas.(46)

Although the evidence was limited, two studies in the review found peer support in combination with other activities, to be a promising avenue for improving access to health services. However, it is difficult to disentangle how much peer support contributed to the overall effectiveness of the intervention and thus further evidence in this area is warranted.

Incentives

Incentives for use of health services address financial constraints, as recipients typically either do not incur fees for service or receive food at the health appointment. Financial barriers to accessing health care are regularly reported in the literature, as the direct and indirect costs of seeking care can be prohibitive for many people in LMIC.(42) Incentives are typically described as demand-side interventions, and have the potential to reach those people who would not otherwise receive health care due to financial barriers such as the rural poor. Three included studies assessed interventions that included a primary component of incentives, conducted in India, Uganda and Nicaragua. All found positive results, with varying strength of evidence. Our findings concur with a previous review conducted by Kesterton et al. (2010), which concluded that incentives showed promise for increasing demand for sexual and reproductive health services, however more studies were needed.(43) This review focussed on interventions aiming to generate demand and community support for sexual and reproductive health services for young people and both included grey and published literature. Thus including broader range of outcome (e.g knowledge and contraceptive use) and intervention types (e.g. use of media).

In addition to addressing inequities in access, competitive voucher programmes can also have positive effects on quality of care for both recipients and non-recipients seeking care as providers raise quality to attract voucher users.(47) A single study in this review evaluated vouchers for sexual reproductive health in Nicaragua and found positive results on uptake of services. Further rigorously evaluated studies in different settings are needed to understand the potential success of such programmes. Similarly, a review by Bellows et al. (2010) on vouchers for reproductive health found that these programmes had a positive impact, however this review did not focus specifically on children. Authors suggested more research is needed to fully understand the causal relationship and the conditions in which these programmes function optimally.(48) Although incentive programmes have shown promising results in this and other reviews, there may be limitations in sustainability of such programmes due to high costs.

Outreach

In many LMICs, health services are concentrated in urban areas which creates substantial logistical barriers to access for those living in rural areas, such as lack of and cost of transport.(9) Geographic barriers are commonly reported in the literature.(42) This review identified a single study that addressed these supply side, geographical barriers: a school-based outreach programme for schistosomaisis treatment was compared to community-based treatment in Brazil. The study found improvements diagnosis coverage, but not treatment compliance. Our previous review on interventions to increase access to health services for children under five identified several studies that focus on delivery of health services and health promotion by community health workers.(14) Community health workers have played a key role in decentralising health services, increasing the health workforce, and improving access to health for people living in many LMIC.(49) Previous studies and programmes with community health workers predominantly focus on maternal and child health, and this area is under-explored for children older than five.

SMS appointment reminders

Mobile phone ownership has increased substantially in LMIC in recent years, creating the opportunity to use this relatively low cost technology within health services. Text message reminders aim to increase demand for services through educating and informing health care users. This again addresses barriers related to the acceptability of health services and lack of awareness about services.(42) Our review found that SMS or phone call reminders increased attendance at cataract appointments, and improved vaccination uptake in China and Turkey respectively.

Given that phone calls are two-way communication, allowing dialogue with patients, whereas SMS reminders are typically one-way communication, further exploration of the differences in

acceptability and effectiveness of these types of communication is required. Despite the small number of studies, these findings agree with previous reviews on text message reminders for access to health suggesting that this is a promising area for future programmes.(50-52) These reviews, focussing on different age groups to this review, have found mobile phone reminders generally improved attendance at health appointments among adults (50), health care outcomes (all ages, mainly high-income) (52), and ART adherence among adults (51).

Process indicators

Our review found that process indicators are not routinely reported in intervention studies. For instance, only half of studies considered contextual factors that may have caused contamination between intervention and control groups. However these studies did not consider the wider system level contextual factors that may impact on an intervention's success or failure. These details, alongside other process indicators such as fidelity, dose, implementation and mechanism of impact are crucial for understanding how interventions influence access to health care services.(53) This review is in agreement with many other reviews in the finding that studies evaluating complex interventions do not often report process indictors, making it difficult for decision makers to understand how a certain intervention could be applied in their context.(14) In addition, these factors are important when interpreting results within a systematic review to understand whether similar interventions are delivered in the same way, or why the outcome of the same intervention might be different in different contexts.(53) Further work is needed to ensure reporting of process indicators.

Implications

The current review synthesises the most up-to-date peer-reviewed research available on the effectiveness of interventions to improve access to health services for children over five in LMIC, a previously neglected group in global health policy.

Overall, the interventions showed positive effects on access outcomes, across all intervention types, and disease groups. However, there were few eligible studies included in the review, included studies examined a range of interventions in various settings, and the quality of these studies varied. Thus, drawing strong conclusions is not straightforward. The long-term impact of these interventions, after the intervention is withdrawn, is also not understood. Most studies in this review did not include information on fidelity and other key process indicators, making it difficult to interpret findings and make judgements about generalisability.

Given the limited number of studies and varied intervention types, further research on effectiveness of all types of interventions identified in the study is warranted. High quality trials of health interventions are needed, with evaluations of complex interventions adhering to Medical Research Council (MRC) guidance on evaluating complex interventions.(53) The review has found some evidence to support educational interventions, school-based treatment (outreach), incentives, and text-message reminders. Peer support, health worker training, and community mobilisation also showed promising results, in combination with other components. The majority of the studies in this review focussed on sexual and reproductive health needs of adolescents (aged 10-19 years), and further evidence is required for a broader range of health needs and age groups. A limited number of studies focused on children between 5 and 10 years of age (n=3) and further evidence is necessary for this neglected age group who have different health needs to adolescents.

The vast majority of included studies were considered to be demand side interventions targeting individual, household or community level factors, including: incentives, education, peer support, community mobilisation, and SMS reminders. Two of these studies included health worker training, targeting health systems characteristics (supply side). One study focussed on supply side activities alone through provision of schistosomaisis treatment in schools. Further evidence is required assessing supply and demand side interventions in combination in order to tackle the

multiple existing barriers and improve care seeking and uptake of services. There is also a need for evidence from a greater variety of contexts, as the majority of studies in this review were conducted in countries in sub-Saharan Africa.

Achieving UHC and the SDGs will not be possible without considering children over five and their access to health services. However, there is limited evidence in this and other reviews on the most effective approach to take in addressing barriers to accessing health services for children over five.

Strengths and limitations

Our review has several strengths. A systematic approach to was used for searching, screening, appraising and extracting data from studies, and two reviewers checked each phase of the search. We followed the evidence-based PRISMA statement to report the findings in the review and conducted a thorough quality review of all included articles. In an attempt to minimise citation bias, we reviewed references of included studies and relevant systematic reviews identified in our search.

There were some limitations that should be taken into account when interpreting the findings of this review. Although we did not restrict our search in terms of language, we only used English search terms and few French or Spanish citations were retrieved. Therefore, relevant evidence from francophone Africa and Latin America may have been missed. We used outcome as a screening criteria because we were particularly interested in access to health care as a result of the intervention. We may have missed some relevant literature that measured other health related-outcomes.

Our review focussed only on peer-reviewed studies that used RCT, and NRS designs to reduce risk of bias. However, the types of interventions that address access to health care services are often complex and challenging to evaluate using these designs. This, we may have missed

relevant interventions evaluated using other study designs or published in grey literature. For instance, no studies were identified that measured the impact of conditional cash transfers on adolescents. Several studies were identified for our previous review of children under five, however these studies did not measure access outcomes for older children. Many other initiatives to improve access to health for older children and adolescents may have been or are being undertaken in LMIC, but have not undergone formal evaluation. Thus, interventions included in the review may not be representative of all interventions in terms of their effectiveness in improving access to health services children over five. Given the lack of evidence, monitoring and evaluation, and dissemination of findings, of all interventions to improve access to health services is crucial.

In this review, the impact of interventions on equity was not explored and this needs further attention. In addition, this review did not shed light on quality of services received, which is an important dimension of access to health. Quality of care is important for acceptability of services, and continued care seeking behaviour and further research is required to understand how this may influence the effectiveness of interventions. Finally, none ot the included studies assessed cost-effectiveness of the interventions and this warrants further investigation.

Conclusions

This review has identified the range and effectiveness of interventions that can be used to increase health care access for children over five in LMIC. However, there were very few studies of high quality included in the review and therefore strong conclusions about the effectiveness cannot be drawn. All intervention types identified in the review found improvements in measured outcomes related to health services access, with varying strength. The limited number of studies and weak evidence means that further evidence is needed on the effectiveness of all types of interventions included in the review: SMS/phone call reminders,

incentives, outreach, education, and multi-component interventions. This evidence will be vital for informing policy makers and programme on which interventions to scale-up to improve access to health for children over five in resource-constrained areas.

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Consent for publication: Not applicable

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Author contributions: TB conducted the searches of the literature, screened titles, abstracts and full text of articles, extracted and interpreted data and wrote the first draft of the manuscript. SP conduced secondary screening of titles, abstracts and full text of articles, checked data extracted by TB, and assisted with writing of the manuscript. HK provided secondary screening of titles, abstracts and full text of articles. LF compiled search terms and assisted with writing the manuscript. All authors read and approved the final manuscript.

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Authors' information (optional)

References

1. Jahan NK, Allotey P, Arunachalam D, Yasin S, Soyiri IN, Davey TM, et al. The rural bite in population pyramids: what are the implications for responsiveness of health systems in middle income countries? BMC Public Health. 2014;14(Suppl 2):S8-S.
2. United Nations. World Population Prospects 2015 [cited 2017 15/09]. Available from: https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf.
3. World Health Organization. World Report on Ageing and Health 2015 [cited 2018 05/02]. Available from: http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf?ua=1
4. Delaney L, Smith JP. Childhood Health: Trends and Consequences over the Life-course. The Future of children / Center for the Future of Children, the David and Lucile Packard Foundation. 2012;22(1):43-63.
5. United Nations. Millennium Development Goals 2006 [cited 2016 16/06]. Available from: http://www.unmillenniumproject.org/goals/.
6. United Nations. Sustainable Development Knowledge Platform 2015 [cited 2016 16/06]. Available from: https://sustainabledevelopment.un.org/.
7. Patton GC, Sawyer SM, Santelli JS, Ross DA, Afifi R, Allen NB, et al. Our future: a Lancet commission on adolescent health and wellbeing. The Lancet. 2016;387(10036):2423-78.
8. World Health Organisation. Millenium Development Goals (MDGs) 2015 [cited 2016 15/06]. Available from: http://www.who.int/mediacentre/factsheets/fs290/en/.
9. O'Donnell O. Access to health care in developing countries: breaking down demand side barriers. Cad Saude Publica. 2007;23(12):2820-34.
10. Bashour HN, Kharouf MH, Abdulsalam AA, El Asmar K, Tabbaa MA, Cheikha SA. Effect of postnatal home visits on maternal/infant outcomes in Syria: a randomized controlled trial. Public Health Nurs. 2008;25(2):115-25.
11. Ensor T, Cooper S. Overcoming barriers to health service access: influencing the demand side. Health Policy Plan. 2004;19(2):69-79.
12. Oyo-Ita A, Wiysonge CS, Oringanje C, Nwachukwu CE, Oduwole O, Meremikwu MM. Interventions for improving coverage of childhood immunisation in low- and middle-income countries. Cochrane Database of Systematic Reviews. 2016(7).
13. Lagarde M, Haines A, Palmer N. Conditional cash transfers for improving uptake of health interventions in low- and middle-income countries: a systematic review. Jama. 2007;298(16):1900-10.
14. Bright T, Felix L, Kuper H, Polack S. A systematic review of strategies to increase access to health services among children in low and middle income countries. BMC Health Services Research. 2017;17(1):252.
15. Oringanje C, Meremikwu MM, Eko H, Esu E, Meremikwu A, Ehiri JE. Interventions for preventing unintended pregnancies among adolescents. Cochrane Database of Systematic Reviews. 2016(2).
16. Dobbins M, Husson H, DeCorby K, LaRocca RL. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. Cochrane Database of Systematic Reviews. 2013(2).
17. Mason-Jones AJ, Sinclair D, Mathews C, Kagee A, Hillman A, Lombard C. School-based interventions for preventing HIV, sexually transmitted infections, and pregnancy in adolescents. Cochrane Database of Systematic Reviews. 2016(11).
18. Harrison A, Newell M-L, Imrie J, Hoddinott G. HIV prevention for South African youth: which interventions work? A systematic review of current evidence. BMC Public Health. 2010;10:102-.
19. Thomas RE, Baker PRA, Thomas BC, Lorenzetti DL. Family-based programmes for preventing smoking by children and adolescents. Cochrane Database of Systematic Reviews. 2015(2).

20. Hefler M, Liberato SC, Thomas DP. Incentives for preventing smoking in children and adolescents. Cochrane Database of Systematic Reviews. 2017(6).
21. Gottschalk LB, Ortayli N. Interventions to improve adolescents' contraceptive behaviors in low- and middle-income countries: a review of the evidence base. Contraception. 2014;90(3):211-25.
22. Lopez LM, Bernholc A, Chen M, Tolley EE. School-based interventions for improving contraceptive use in adolescents. Cochrane Database of Systematic Reviews. 2016(6).
23. Dick B, Ferguson J, Chandra-Mouli V, Brabin L, Chatterjee S, Ross DA. Review of the evidence for interventions to increase young people's use of health services in developing countries. World Health Organ Tech Rep Ser. 2006;938:151-204; discussion 317-41.
24. Lagarde M, Palmer N. The impact of contracting out on health outcomes and use of health services in low and middle-income countries. Cochrane Database Syst Rev. 2009(4):Cd008133.
25. Witter S, Fretheim A, Kessy FL, Lindahl AK. Paying for performance to improve the delivery of health interventions in low- and middle-income countries. Cochrane database of systematic reviews (Online). 2012;2:CD007899.
26. Briggs CJ, Garner P. Strategies for integrating primary health services in middle- and low-income countries at the point of delivery. Cochrane Database Syst Rev. 2006(2):Cd003318.
27. Eldridge C, Palmer N. Performance-based payment: some reflections on the discourse, evidence and unanswered questions. Health Policy Plan. 2009;24(3):160-6.
28. PRISMA. Prisma Statement 2015 [cited 2016 16/06]. Available from: http://www.prisma-statement.org/PRISMAStatement/Default.aspx.
29. Petticrew M, Anderson L, Elder R, Grimshaw J, Hopkins D, Hahn R, et al. Complex interventions and their implications for systematic reviews: a pragmatic approach. J Clin Epidemiol. 2013;66(11):1209-14.
30. Effective Public Health Practice Project. Quality Assessment Tool For Quantitative Studies 2009 [cited 2016 03/03]. Available from: http://www.ephpp.ca/tools.html.
31. Saunders RP, Evans MH, Joshi P. Developing a Process-Evaluation Plan for Assessing Health Promotion Program Implementation: A How-To Guide. Health Promotion Practice. 2005;6(2):134-47.
32. Burnett SM, Weaver MR, Mody-Pan PN, Thomas LA, Mar CM. Evaluation of an intervention to increase human immunodeficiency virus testing among youth in Manzini, Swaziland: a randomized control trial. J Adolesc Health. 2011;48(5):507-13.
33. Aninanya GA, Debpuur CY, Awine T, Williams JE, Hodgson A, Howard N. Effects of an adolescent sexual and reproductive health intervention on health service usage by young people in northern Ghana: a community-randomised trial. PLoS One. 2015;10(4):e0125267.
34. Kundu CK, Samanta M, Sarkar M, Bhattacharyya S, Chatterjee S. Food supplementation as an incentive to improve pre-antiretroviral therapy clinic adherence in HIV-positive children--experience from eastern India. J Trop Pediatr. 2012;58(1):31-7.
35. Lin H, Chen W, Luo L, Congdon N, Zhang X, Zhong X, et al. Effectiveness of a short message reminder in increasing compliance with pediatric cataract treatment: a randomized trial. Ophthalmology. 2012;119(12):2463-70.
36. Meuwissen LE, Gorter AC, Knottnerus AJ. Impact of accessible sexual and reproductive health care on poor and underserved adolescents in Managua, Nicaragua: a quasi-experimental intervention study. J Adolesc Health. 2006;38(1):56.
37. Okonofua FE, Coplan P, Collins S, Oronsaye F, Ogunsakin D, Ogonor JT, et al. Impact of an intervention to improve treatment-seeking behavior and prevent sexually transmitted diseases among Nigerian youths. Int J Infect Dis. 2003;7(1):61-73.
38. Bhana A, Mellins CA, Petersen I, Alicea S, Myeza N, Holst H, et al. The VUKA family program: piloting a family-based psychosocial intervention to promote health and mental health among HIV infected early adolescents in South Africa. AIDS Care. 2014;26(1):1-11.

39. Favre TC, Pereira AP, Beck LC, Galvao AF, Pieri OS. School-based and community-based actions for scaling-up diagnosis and treatment of schistosomiasis toward its elimination in an endemic area of Brazil. Acta Trop. 2015;149:155-62.
40. Muhumuza S, Olsen A, Katahoire A, Kiragga AN, Nuwaha F. Effectiveness of a pre-treatment snack on the uptake of mass treatment for schistosomiasis in Uganda: a cluster randomized trial. PLoS Medicine. 2014;11(5).
41. Çamurdan AD, Çamurdan MO, Beyazova U, Dalgıç B, Bideci A, Karakuş R. The effect of intervention on vaccination rates in children with diabetes: a controlled interventional study. International Journal of Diabetes in Developing Countries. 2015;35(2):76-83.
42. Jacobs B, Ir P, Bigdeli M, Annear PL, Damme WV. Addressing access barriers to health services: an analytical framework for selecting appropriate interventions in low-income Asian countries. Health Policy & Planning. 2012;27.
43. Kesterton AJ, Cabral de Mello M. Generating demand and community support for sexual and reproductive health services for young people: A review of the Literature and Programs. Reproductive Health. 2010;7(1):25.
44. Case A, Fertig A, Paxson C. The lasting impact of childhood health and circumstance. Journal of Health Economics. 2005;24(2):365-89.
45. Viner RM, Ozer EM, Denny S, Marmot M, Resnick M, Fatusi A, et al. Adolescence and the social determinants of health. The Lancet.379(9826):1641-52.
46. Bekker L-G, Hosek S. HIV and adolescents: focus on young key populations. Journal of the International AIDS Society. 2015;18(2Suppl 1):20076.
47. The World Bank. A guide to competitive vouchers in health 2005. Available from: http://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/Peer-Reviewed-Publications/AGuidetoCompetitiveVouchersinHealth.pdf.
48. Bellows NM, Bellows BW, Warren C. Systematic Review: The use of vouchers for reproductive health services in developing countries: systematic review

L'utilisation de bons pour les services de santé reproductive dans les pays en développement: revue systématique

El uso de cupones en los servicios de salud reproductiva de países en vías de desarrollo: revisión sistemática. Tropical Medicine & International Health. 2011;16(1):84-96.
49. Haines A, Sanders D, Lehmann U, Rowe AK, Lawn JE, Jan S, et al. Achieving child survival goals: potential contribution of community health workers. The Lancet. 2007;369(9579):2121-31.
50. Car J, Gurol-Urganci I, de Jongh T, Vodopivec-Jamsek V, Atun R. Mobile phone messaging reminders for attendance at healthcare appointments. Cochrane Database Syst Rev. 2012(7):Cd007458.
51. Horvath T, Azman H, Kennedy GE, Rutherford GW. Mobile phone text messaging for promoting adherence to antiretroviral therapy in patients with HIV infection. Cochrane Database Syst Rev. 2012(3):Cd009756.
52. Kannisto AK, Koivunen HM, Välimäki AM. Use of Mobile Phone Text Message Reminders in Health Care Services: A Narrative Literature Review. J Med Internet Res. 2014;16(10):e222.
53. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ. 2015;350.

Figure legends

Figure 1 : Flow chart of search result

Appendices

- Appendix 1: Search strategy
- Appendix 2: Risk of bias of included studies
- Appendix 3: Study details
- Appendix 4: Process indicators

1 Appendix 2: Quality assessment of included studies (using EPHPP tool)

Author	Study design	Score for study design	Selection bias (recruitment)	Confounders	Blinding	Withdrawals and dropouts (reach)	Data collection	Global quality rating
Camurden et al (2015)	Controlled before- and after- study	Moderate: not an RCT	Moderate; somewhat likely to represent target population (hospital selection); 80-100% agreed to participate	Weak: Groups different at baseline; confounders not controlled for	Moderate: cannot tell if participants blinded to research question, or outcome assessors blinded	Weak: withdrawals and drop outs not reported	Moderate: self reported measures	Weak: two weak ratings
Kundu et al (2012)	Prospective longitudinal clinic-based observational study	Weak: clinic-based observational study	Moderate: somewhat representative of target population; 80-100% agreed to participate. However, children of migrant workers excluded from study.	Strong: no important differences between groups.	Moderate: cannot tell if outcome assessors blinded or participants blinded to research question	Strong: withdrawals/dropouts described; 60 - 79% completed study	Moderate: self report, but also measured serologic studies of vaccination	Moderate: one weak rating
Meuwissen et al. (2006)	Quasi experimental intervention study	Moderate: quasi experimental study	Moderate: somewhat likely to be representative of target population – distributed vouchers in multiple locations and surveyed in multiple sites; 80-90% agreed to participate	Strong: did not do baseline survey, only follow-up, adjusted confounders in analysis	Strong: outcome assessors not aware, participants not aware of research question	Strong: withdrawals and drop outs not applicable (one off questionnaire), response rate high	Moderate: self reported measures	Strong: no weak ratings
Aninyana, 2015	cRCT	Strong: cRCT; Simple randomisation used and allocation concealed using sealed envelopes not sequentially numbered or opaque	Strong: Home visits by trained research assistants for adolescents. Intervention recruitment varied- multi component intervention.	Weak: Higher percentage of comparison participants attended primary school, identified as Catholic, and a lower percentage identifying as Muslim. Analysis adjusted for baseline usage and clustering, but not other a priori confounders	Moderate: participants and personnel not blinded, outcome assessors not reported	Moderate: loss to follow up high (60-79% in intervention 80%+ in control), however similar between intervention and control and reasons for drop out similar.	Moderate: self reported measures used. However, recall bias possible as participants were asked to recall over 12-month period (however results should be balanced between groups). Clustering accounted for using random effects	Weak: one weak rating
Bhana, 2014	RCT	Strong: Described as RCT. However, randomisation	Weak: Participants who agreed to be part of the study (caregivers	Weak: Differences at baseline. Not	Moderate: participants and personnel not	Low risk: 32/33 families attended.	Strong: self-reported adherence	Weak: one weak rating

		method and allocation concealment mot reported.	approached in clinic waiting rooms were referred to the study project director) if they expressed interest and had a child who met study criteria. Among the 74 families enrolled, 65 completed baseline assessment and were then randomly assigned to receive VUKA immediately or approximately 3 months later, after both groups had completed a post evaluation (87%)	controlled for in analysis.	blinded, outcome assessors not reported	100% completed; 94% attending 5/6 days and 55% attending all 6 days. Reasons for not attending specified. No difference in rates by site.	measures (however results should be balanced between groups)	
Burnett, 2011	RCT	Strong: Described as RCT; Students randomly assigned, but method of randomisation and allocation concealment not described.	Moderate: All 312 students in Form 2 (grade 9) and Form 4 (grade 11) were invited to participate, and 204 (204/312=66%) students, 101 males and 103 females, were enrolled on a first-come, first-serve basis. 66.5% completed surveys at pre and post intervention (low response rate)	Strong: Some differences in baseline scores, controlled for in analysis.	Moderate: participants, self-completed questionnaire and facilitated by external study personnel (outcome assessors blinded), and personnel not blinded	Moderate: 66.5% of participants completed pre and post surveys. Attrition not significant by gender or by intervention of control group. Incomplete information for 33% students about sexual behaviour. 10 students in intervention and 11 in control group did not answer about HIV status pre and post intervention. No difference found between these individuals and those who completed.	Moderate: Self-reported measures on sensitive data and collected data and collected at the school which might have led to bias reporting.	Strong: one weak rating
Favre, 2015	RCT	Strong: Described as RCT, However, randomisation method and allocation concealment not specified	Strong: All children aged 6–15 years who were enrolled in the 10 public schools of Aracoiaba in 2009 were assessed for eligibility, totalling 3190 (86% of the total population in this age-group).	Strong: adjusted for age and area	Moderate: blinding not reported	Strong: reported attrition, small proportion of children absconded diagnosis in both groups, however similar proportions.	Strong: valid and reliable tools used. Chance of bias in treatment coverage results due to moderate-to-high egg-positivity of S. mansoni in 3/4 urban schools drawn for community intervention scheme having no counterpart in the urban schools in	Strong: no weak ratings

							the school intervention scheme. Thus, in urban area 165 children were entitled to treatment at the schools, compared to 424 in the community. In the rural area, where 23 positives were identified in the school scheme and 37 in the community scheme, 22 (95.7%) and 35 (94.6%), respectively, were treated.	
Muhumuza, 2013	RCT	Strong: RCT. Randomisation by computer generated program, and randomisation was performed by an independent statistician	Strong: School selection not specified, but was part of government programme in Walukuba Division in Jinja District. Children within schools randomly selected, using systematic sampling (for measurement of outcome). Children were invited according to their grade to receive treatment.	Strong: no differences at baseline	Moderate: participants not blinded, personnel not blinded, but outcome assessors were blinded	Strong: reported attrition, and low in both intervention and control (25 intervention participants, 7 control)	Moderate: outcome was self reported uptake (but unlikely to effect study outcome). Accounted for clustering in analysis	Strong: no weak rating
Okonofua, 2003	RCT	Strong: Described as RCT, However randomisation method and allocation concealment not reported	Strong: Multistage sampling; Schools: Four secondary schools in Benin City randomly selected to participate in the intervention program. Another four secondary schools in Benin City randomly selected as control schools that received no intervention. In order to have equal representation of boys and girls in the intervention, sampled single-sex schools and co-educational schools separately.	Weak: Some baseline differences in intervention and 1 control group, not accounted for in analysis.	Strong: participants not blinded, outcome assessors blinded (self completed questionnaire), personnel not blinded	Strong: 1896 at baseline 1885 at follow-up participated in questionnaire, subjects re-sampled at baseline and followup (i.e. different children)	Moderate: self reported attendance data, however self-completed	Weak: one weak rating

			Schools randomly selected from each list using simple balloting. At each of the selected schools, 320 students in senior classes 4 and 5. In each school in the intervention and control sites, randomly selected 160 subjects to participate in the pre and post intervention interviews					
Lin, 2012	RCT	Strong: RCT. Simple randomisation using random number generator and allocation using sealed opaque envelope	Strong: Pre and post operative patients with cataract and no other ocular abnormalities, enrolled in Childhood Cataract Program recruited from Zhongshan Opthalmic centre (ZOC) in Guangzhou. This hospital draws patients from across China. Parents had to own a mobile phone and be literate.	Strong: No significant differences at baseline	Moderate: participants no, personnel no, outcome assessors yes	Strong: no participant withdrew from the study after randomisation	Strong: attendance at appointments documented by clinical staff	Strong: no weak ratings

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1 Appendix 3: Details of included studies

	Author (Year)	Country and setting (urban or rural)	Design and population	Intervention (Int) and control (Con)	Intervention group	Delivery mode	Main outcome of interest (HCU= health care utilisation; I=immunisation; C=compliance)	Result summary
1	Favre (2015)	Brazil, mixed	School based RCT; Children aged 6-15 years; n=3,092	Int: School based programme for delivery of diagnosis and treatment of schistosomaisis Con: Community based schistosomaisis control programme	Outreach	School-based	C: Diagnosis coverage (proportion of children who were diagnosed); treatment compliance	S.Mansoni treatment compliance: Baseline: school 90.4%, community 88.5%; NS 12 months: school 82.4%, community 77.3%; NS Soil transmitted helminth treatment compliance Baseline: school 96.4%, community 93.9%; NS 12 months: school 59.6%; community 64.4%; NS Diagnosis coverage Baseline: Adj OR=1.95 (1.64–2.32) 12 months: Adj OR=1.87(1.25–2.78) **Result: Mixed positive**
2	Muhumuza (2013)	Uganda, mixed	cRCT, Primary school children (7-16 years); n=1,284	Int: Pre schistosomaisis treatment snack, 30 minute educational session covering key health messages about schistosomaisis (teacher delivered) (6 schools) Con: Educational messages only (6 schools)	Multi-component intervention (Incentive + education)	School-based	C: Uptake of praziquantel treatment (swallowed drug during mass treatment)	Non snack 78.7% Snack 93.9 p=0.002 **Result: Positive**
3	Camurden (2015)	Turkey, urban	CBA; Children with diabetes under 20 years; n=231	Int: Vaccination recommendation by social paediatrician and up to 2 phone call reminders Con: One phone call reminder. Hospital controls.	Text message/phone call reminders	Clinic-based	I: Vaccination status (Hep A, Hep B, measles, mumps, varicella, mumps, PCV, Td)	Hepatitis B: pre 98.8%; post 98.8%; NS Hepatitis A: pre 4.3%; post 78.5%; p=0.0001 Measles: pre 98.6%; post 100%; NS Mumps: pre 22.7%; post 37.4%; NS Varicella: pre 2.5%; 17.2%; p=0.0001 PCV13: pre 12.2%; post 48.8%; p=0.0001 PCV23: pre 3.8%; post 93.8%; p=0.001

								Td (adult-type diptheria and tetanus): pre 96.6%; post 100%; NS **Result: Mixed positive**
4	Bhana (2014)	South Africa, mixed	RCT; Children 10-14 years enrolled in HIV care; n=65	Int: "VUKA family programme" Psychosocial intervention for youth living with HIV to promote health and mental health. Consisted of collaborative HIV prevention and adolescent mental health family programme delivered by lay counsellor. Intervention used cartoon storyline and curriculum telling the story of a 12 year old boy orphansed by AIDS who moves in with relatives and learns about this own HIV diagnosis and treatment needs, whilst coping with family loss, stigma, peer relationships, identity, and family functioning. Sessions include: 1) AIDS related loss; 2) HIV transmission and treatment; 3) Disclosure of HIV status to others; 4) Youth identity, acceptance and coping with HIV 5) Adherance to medical treatment; 6) Stigma and discrimination; 7) Caregiver/child communication; 8) Puberty; 9) Identifying and developing strategies to keep children safe in high risk situations; 10) Social support. Con: No educational programme	Adolescent education	Community-based	C: Youth adherence to ART (last time missed medication)	Control: baseline 4.79, followup 4.36 VUKA: baseline 3.71 followup 4.81 Beta (VUKA vs Control) 1.527 (regression coeff obtained from GLM model) p=0.05 **Result: Positive**
5	Burnett (2011)	Swaziland, urban	RCT; students in grades 9 and 11 at one school; n=135	Int: Educational programme "It's Our Future Too" delivered by teacher including modules on: HIV and sexually transmitted infection basics, life skills on HIV awareness and prevention, testing of HIV, stigma and discrimination Con: No intervention	Adolescent education	School-based	HCU: Ever had HIV test	Bivariate Intervention: pre 11 (19%), post 42 (65%) p<0.001 Control: pre 5 (7.6%) post 9 (13.6); NS Multivariate OR=10.96 (4.59–26.15); p<0.001 **Result: Positive**
6	Okonofua (2003)	Nigeria, urban	cRCT; In school adolescents (14-18 years) in 8	Int: 1. Reproductive health club in each school to provide a forum for interaction between the adolescents on reproductive health matters; 2) Training of peer educations to provide peer	Multi-component intervention (adolescent education+peer	School and clinic based	HCU: Treatment seeking behaviour at various providers	*Proportion seeking treatment from a private provider for STIs* Change from pre to post intervention Intervention: OR=3.24 (1.84, 5.73)

			secondary schools in Benin city (4 schools intervention, 4 schools control) and 4 control schools in Ekpoma n=3754	education/support; 3) Training of sexually transmitted disease health providers Focus of the health worker training varied by provider. For pharmacists, training was provided in simple treatment, condom promotion, and the importance of referral to trained private practitioners. For private doctors, they were trained to use standard WHO protocols and algorithms and to refer difficult cases to tertiary hospitals. Con: Usual services	support+health worker training)			Control group 1 (Benin): OR=1.75 (1.51, 2.03) Control group 2 (Ekpoma): OR=1.38 (0.75, 2.56) <u>Change relative to control group</u> Control 1: Adj OR=1.85 (1.06, 3.22) Control 2: Adj OR=2.35 (1.03, 5.17) Both controls: Adj OR=2.10 (1.10-3.99) *Proportion seeking care from hospital/clinic* <u>Change from pre to post intervention</u> Intervention: OR=0.93 (0.43, 2.00) Control group 1: OR=1.65 (0.90, 3.05) Control group 2: OR= 1.28 (0.74, 2.21) <u>Change relative to control group</u> Control 1: Adj OR=1.04 (0.39, 2.78) Control 2: Adj OR=0.55 (0.22, 1.39) Both controls: Adj OR=0.73 (0.31, 1.71) **Result: Mixed positive**
7	Aninyana (2015)	Ghana, mixed	cRCT; Adolescents aged 10-24 years; n=2,664	Int: Adolescent sexual reproductive health programme comprising 1) Community mobilisation; 2) Health worker training in youth friendly health services; 3) School based sexual and reproductive health education; 4) peer education for out of school adolescents Con: Health worker training and community mobilisation only	Multi-component intervention (community mobilisation+health worker training+adolescent education+peer support)	School and community based	HCU: STI management service usage; HIV testing and counselling service usage; perinatal care service usage	STI management service usage: Adj OR=2.47 (1.78-3.42) HIV testing and counselling service usage: Adj OR=1.16 (0.85-1.58) Perinatal care service usage: Adj OR=1.89 (1.37-2.60) **Result: Mixed positive**
8	Meuwissen (2006)	Nicaragua, urban	NRS; Poor female adolescent aged 12 to 20 years; N= 3,009 NB: 39.2% non receivers >18 years; 42.9% receivers	Int: Competitive (competition between providers) voucher programme for sexual and reproductive health care for adolescents to strengthen demand and improve efficiency and quality of providers delivering sexual and reproductive health care. Delivered alongside educational booklet in low-income neighbourhoods and outside public schools. Con: No vouchers	Multi-component intervention (Incentive + education)	Community-based	HCU: Using SRHC within 15 months before the survey	Adj OR=3.1; (2.5–3.8) **Result: Positive**

9	Kundu (2012)	India, urban	Longitudinal study; Children 2-12 years with HIV n=100 in group 1 (no intervention - first year), 80 in group 2 (intervention - second year)	Int: Incentive scheme: provision of supplementary nutrition as monthly take home rations for children attending paediatric HIV/AIDS clinic. Con: Usual	Incentive	Clinic-based	HCU: Percentage irregular clinic visits; clinic adherence (>90% of 2 monthly visits); percentage higher attendance	Percentage irregular clinic visits: OR=2.89 (1.09-7.63) Clinic adherence: OR= 3.00 (1.27, 7.08) Percentage higher attendance: Increased from 5 to 20%, p<0.001 **Result: Positive**
10	Lin (2012)	China, urban	RCT; pre and post-operative cataract patients aged <18 years; n=258	Int: SMS appointment reminders for children with cataract Con: No reminders	Text message/phone call reminders	Clinic-based	HCU: Number of follow-up appointments attended	Risk ratio=1.47 (1.16-1.78) **Result: Positive**

1 Appendix 4: Process indicators

Author	**Fidelity** Extent to which the intervention was implemented as planned.	**Dose delivered (completeness)** Amount or number of intended units of each intervention or component delivered or provided by interventionists.	**Dose received (exposure)** Extents to which participants actively engage with, interact with, are receptive to, and/or use materials or recommended resources: can include "initial use" and "continued use	**Dose received (satisfaction)** Participant (primary and secondary audiences) satisfaction with program, interactions with staff and/or investigators.	**Contamination/context** Aspects of the environment that may influence intervention implementation or study outcomes; includes contamination or the extent to which the control group was exposed to the program.
Camurden et al (2015)	Not reported	Not reported	Not reported	Not reported	Used hospital controls who attended same clinic as those with diabetes (chronic liver disease controls). Unclear if there was a risk of contamination. Social paediatrician and phone call reminders occurred outside the clinic setting so unlikely.
Kundu et al (2012)	Not reported	Not reported	Not reported	Not reported	Intervention not given to anyone in the first year, but given in the second year to only eligible families.
Meuwissen et al. (2006)	Not reported	28,771 vouchers distributed to male and female adolescent areas of Managua. Unclear on the number of units received, assume one - but it is possible that one person could receive more than one voucher depending on need.	Not reported	Focus group discussions and interviews with adolescents suggest that the factors that contributed to the success of the voucher program were the removal of practical obstacles (e.g., financial, the need to make an appointment, the lack of information on clinic location, and opening times) plus the guarantee of confidential access to a service provider of their choice.	The impact of the intervention was evaluated through self-administered questionnaires completed by female adolescents in places where vouchers had been distributed, focussing on the use of SRHC and knowledge and use of contraceptives and condoms. Comparison was between voucher receivers and non-receivers - based on self-report of receipt. Thus not really a control group. Unclear if comparison group exposed to intervention.
Aninyana, 2015	Not reported	Not reported	Not reported	28.3% of comparison and 43.2% of intervention groups reported satisfaction with health services at followup. No other satisfaction outcomes measured	Unclear how close the intervention and control communities are based on methods. Possible contamination could have occurred.

Bhana, 2014	The curriculum provides step-by-step guidance for counsellors to deliver critical information to facilitate discussions and problem solving within and between families in multi-family groups. HIV infected youth and their primary caregiver come together with other affected families for sessions, which include both multiple family group activities and separate parent and child group activities. Plan was to deliver 6 sessions over a 3 month period. Result: unclear on quality, but lay counsellors were supervised.	The intervention was administered in 6 sessions over a 3-month period (two Saturdays a month) based on participant and provider feedback concerning feasibility and space. Intervention facilitators were primarily lay counsellors and one masters-level psychologist who also provided supervision after initial training by the study team.	Among 33 families randomised to the VUKA arm, 32 attended at least one session, 100% of whom completed it, with 94% attended at least 5 of the 6 days and 55% attending all 6 days. The most common reasons for not attending were illness and family time conflicts. There were no differences in rates of attendance by site.	Focus group discussions with participants revealed: 1) VUKA helped improve adherence as children realised that hey were not the only ones on medication and became hopeful about their future; 2) improved self-concept and future orientation; 3) improved social support; 4) talking about sensitive topics; 5) diffusion of the programme to other family members	Potential cross contamination between intervention and control students as study only conducted in one school.
Burnett, 2011	Not reported	13 delivered, but 94% received, and 13 (14.77% of people allocated) students discontinued intervention (left school, conflicting activities on Saturday, no reason given)	Not reported	Not reported	Students were randomly assigned to either the intervention or the delayed intervention group. The latter acted as the control group and did not receive any intervention until after the study (same school). Possible contamination occurred, some students switched groups.
Favre, 2015	The research team monitored the activities of the health teams to assure that the standard procedures recommended by the PCE were followed the same way in either scheme.	One diagnosis and treatment period, then review at 12 months.	Not reported	Not reported	All public schools of the municipality were paired by area (urban or rural) and ranked according to number of eligible children per school. Two sets of 5 matched schools were randomly assigned to either school or community based treatment. Unlikely there was contamination.
Muhumuza, 2013	Not reported	A total of 2,833 children in 6 primary schools received the snack. Not reported in terms of the proportion of children who attend the schools. A total of 5,920 children in the 12 primary schools received the messages. The majority of children in the snack (73.3%) and non-snack (71.4%) schools reported to have received education messages prior to receiving mass treatment. 92.8% of children in snack and 49.8% in non snack schools reported to have eaten something before mass treatment.	Not reported	Not reported	Unlikely to be contamination, as the delivery occurred at the level of the school.
Okonofua, 2003	Not reported	Not reported	Paper states that the majority participated in all of the intervention activities. However,	Paper states: “All participating adolescents showed a high level of enthusiasm for the project, and the majority participated in	Authors measured from a third school not in the intervention study area to control for possible contamination: “Since it is

			more specific details not provided.	all of the intervention activities." Does not appear that this was formally measured.	impossible to restrict the influence of a community based intervention to the specific schools chosen as intervention sites without having some effect on nearby control schools, a second control group of four secondary schools was randomly selected from the secondary schools in a nearby town, Ekpoma"
Lin, 2012	Plan: Four follow-up appointments were scheduled according to the study protocol. Called for 1 visit every month before surgery, and at 1 week, 1 month, 2 months and 3 months, then every 3 months after surgery. If further surgery, or treatment was required - followup appointments would be rescheduled. SMS were planned to be sent 4 days (at 10 am and 4pm) and 1 day (at 10am and 4pm) before their scheduled appointments (total of 4 reminders). Whether the SMS appointment reminder was received by the mobile phone was recorded by the system. If the SMS failed to send, reminder was resent until it was received by mobile phone. Result: 540 appointments scheduled for 135 children in intervention group (average 4 per person). No report on number of SMS received.	Not reported	Not reported	At the end of the study 132/135 (97.8%) of parents in the intervention group reported they would like the SMS programme to continue	Random allocation occurred at individual level, and reminders sent according to individual appointments. Thus, unlikely to be contamination.

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