Evidence from district level inputs to improve quality of care for maternal and newborn health: interventions and findings

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Abstract
District level healthcare serves as a nexus between community and district level facilities. Inputs at the district level can be broadly divided into governance and accountability mechanisms; leadership and supervision; financial platforms; and information systems. This paper aims to evaluate the effectiveness of district level inputs for improving maternal and newborn health. We considered all available systematic reviews published before May 2013 on the pre-defined district level interventions and included 47 systematic reviews. Evidence suggests that supervision positively influenced provider’s practice, knowledge and client/provider satisfaction. Involving local opinion leaders to promote evidence-based practice improved compliance to the desired practice. Audit and feedback mechanisms and tele-medicine were found to be associated with improved immunization rates and mammogram uptake. User-directed financial schemes including maternal vouchers, user fee exemption and community based health insurance showed significant impact on maternal health service utilization with voucher schemes showing the most significant positive impact across all range of outcomes including antenatal care, skilled birth attendant, institutional delivery, complicated delivery and postnatal care. We found insufficient evidence to support or refute the use of electronic health record systems and telemedicine technology to improve maternal and newborn health specific outcomes. There is dearth of evidence on the effectiveness of district level inputs to improve maternal newborn health outcomes. Future studies should evaluate the impact of supervision and monitoring; electronic health record and tele-communication interventions in low-middle-income countries.

Introduction
District level healthcare is the cornerstone of primary health. An ideal district health system should not only offer primary care services but also provide first level of outpatient care and referrals for more specialized care. They also serve as a nexus between community and facility level care for health information; play a direct role in training health care workers; and provide necessary data to guide national health policy. This role is fundamental to effective health care delivery and failure to recognize the interrelationship between community and district-level facilities might result in inefficiency and fragmented delivery of meaningful public health interventions. Community based intervention impacts discussed in paper 2 of this series [1] could not be achieved if district level priorities do not reflect the needs of the community.

District level facilities play a pivotal role for maternal newborn health (MNH) programs. In some countries, programs like Safe Motherhood Initiative and Integrated Management of Childhood Illness (IMCI) are based on district-level health systems. Outpatient clinics at district hospitals provide primary prevention services for MNH including universal maternal and childhood immunizations. However these programs may vary in structure and functioning from country to country depending on the healthcare needs and infrastructure. The core components of district level inputs include training, supervision and monitoring of health workers in the peripheral health centers and managing health information systems for strategic planning and monitoring of the district health system. In this paper, we have reviewed the effectiveness of care

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delivered through district level inputs for improving MNH outcomes. For this review we have broadly categorized these interventions into four categories: governance and accountability mechanisms; leadership and supervision; financial incentives; and information systems.

**District level characteristics**

**Governance and accountability mechanisms**

Governance is achieved through a combination of strategies including clinical competence, patient involvement, risk management, use of information, staff management, maintaining medical registries, and implementation of continuous quality improvement (CQI) tools. Accountability involves audit and feedback mechanisms that entail a systematic approach to ensure that the services are accountable for delivering quality healthcare. Audits involve any summary of clinical performance of healthcare professionals over a period of time which is presented to them in a written, electronic or verbal format for self-accountability. Healthcare professionals are prompted to modify their practice if the feedback is inconsistent with the standards or accepted guidelines. Audit tools for evaluating maternal and perinatal deaths have been an integral part of quality improvement in obstetric care. These are effective in defining the context specific problem and propose solutions. Although these mechanisms have been used widely as a strategy to improve professional practice, they have not shown consistent effectiveness majorly due to the inconsistencies and variations involved in implementation [2,3].

**Leadership and supervision**

Supervision plays a key role in primary healthcare (PHC) service delivery and it requires the district level staff to supervise the public health activities and provide appropriate clinical care [4-6]. Good leadership is also critical to the success of district health systems as it relies on how leaders work together to enable the health system to achieve its goals [7]. It involves strategic planning for the provision of services, resource allocation, and set priorities for improved performance. Aspects of leadership and supervision involve problem solving, reviewing records, observing clinical practice, mentoring and guidance on matters of personal, professional and educational development in context to patient care. Supervision in district health structures is difficult to implement due to time and costs involved and also the increasing numbers of district level facilities in even increasingly remote areas [8]. One of the emerging concepts is the involvement of local opinion leaders in district health leadership to promote knowledge transfer of evidence into practice and ultimately improve health care [9]. Since these individuals are perceived as credible and trustworthy, they may play a key role in assisting individuals to identify the best evidence-based healthcare practice and facilitate behavior change [10].

**Financial incentives**

It involves provision of monetary benefits as a source of motivation for performing desired health related actions. Financial interventions are aimed at creating a greater demand for health services and include scale-up of preventive health interventions, as well as provision of free access to basic health care. In recent years there has been an increase in the utilization of financial support platforms to reduce out of pocket client expenditure and strengthen service delivery and utilization at the district level. The targeted health services can include seeking care, behavior modification, immunization, compliance to health professional’s clinical behavior and performance. Incentives directed towards care providers include capitation (payment for each patient enrolled), fee for service and pay for performance. Those directed towards users involve conditional cash transfers (CCT), vouchers, health insurance and fee exemptions. Diverse and innovative financial support platforms are being implemented in some of the fragile states such as Cambodia, Afghanistan, Pakistan and Haiti as well as more established economies of Latin American countries [11,12] however, impact on quality of care for MNH is still emerging [13].

**Information system**

It is one of the essential building blocks of health system [14] that captures, manages and transmits information related to the health of individuals or activities of organizations. It involves district level routine information systems, disease surveillance, hospital patient administration, electronic health records, human resource management and communication systems. Health information system is vital for public health decision making, health sector reviews, planning and resource allocation and program monitoring and evaluation. Weak information systems are a critical challenge to achieving the MNH related Millennium Development Goals. The major challenges identified in this domain include issues related to completeness, accuracy and timeliness, especially in low middle income countries (LMIC). These challenges limit its use in routine district health care planning, monitoring, and evaluation. Other factors associated with poor quality data in resource constrained settings include duplicate, parallel reporting channels and insufficient capacity to analyze and use data for decision making. Recently, there is an increased emphasis on utilizing electronic communication systems including mobile phones, telephone based follow-up and counseling, after-hours telephone access, and screening. As the field is still nascent, a limited but growing body of evidence exists to support the role of mobile technologies
in improving MNH outcomes [15-17]. Despite the anticipated benefits of mHealth; wide-scale impacts of mHealth on MNH outcomes need to be explored further [18,19].

We aim to systematically review and summarize the available evidence from relevant systematic reviews on the impact of the outlined district level inputs (panel 1) to improve the quality of care for women and newborns.

Methods
We considered all available systematic reviews on the pre-defined district level interventions published before May 2013 as outlined in our conceptual framework [20]. A separate search strategy was developed for each component using pre-identified broad keywords, medical subject heading (MeSH), and free text terms: [(Governance OR accountability OR audit OR feedback OR leadership OR supervis* OR finan* OR incentive OR “cash transfer” OR CCT OR voucher OR insurance OR “user fee” OR exemption OR “pay for performance” OR record* OR data OR electronic “electronic data” OR “information system” OR “electronic information system” OR “electronic communication” OR “telecommunication” OR mhealth OR ehealth) AND (health OR healthcare OR maternal OR mother OR child OR newborn OR “neonat*”)]

Our priority was to select existing systematic reviews, which fully or partly address the a priori defined district level interventions for improving quality of care for MNH. We excluded the reviews pertaining to nursing documentation, computerized pharmacy system or those focusing on certain specific chronic illnesses only as these were not included in the scope of our review.

Search was conducted in the Cochrane library and PubMed and reviews that met the inclusion criteria were selected and data was abstracted by two authors on a standardized abstraction sheet: Quality assessment of the included reviews was done using Assessment of Multiple Systematic Reviews (AMSTAR) criteria [21] as detailed in paper 2 of the series [20]. Any disagreements between the primary abstractors were resolved by the third author. For the pre-identified interventions, which did not specifically report MNH outcomes, we have reported the impacts on other health outcomes as reported by the review authors. Estimates are reported as relative risks (RR), risk ratios (RR), risk differences (RD) or mean differences (MD) with 95% confidence intervals (CI’s) where available. For detailed methodology please refer to paper 1 of the series [20].

Findings
Our search identified 326 potentially relevant review titles. Further evaluation of the abstracts and full texts resulted in the inclusion of 47 eligible reviews: 14 on governance and accountability mechanisms, 7 on leadership and supervision, 11 on financial strategies and 15 on information systems (Figure 1). The overall quality of reviews ranged from 3 to 10 on the AMSTAR criteria with a median score of 8.

Governance and accountability
We included 14 [22-35] reviews evaluating the effectiveness of governance and accountability mechanisms. The median quality score was 7.5 on AMSTAR rating scale. Most of the reviews evaluated a set of pre-selected process and outcome indicators as the outcomes reported in the individual studies varied widely. Three reviews reported MNH related outcomes [22,26,29] including immunization rates, mammography uptake, perinatal and maternal morbidity and mortality. Other reported outcomes included compliance, performance improvement and rate of prescription for generic drugs. Most of the studies included in these reviews were conducted in high income countries (HIC). The characteristics and findings of the included reviews are presented in Table 2.

The effectiveness of audit and feedback mechanisms varied widely for various outcomes ranging from nil to moderate effect. Implementation involved a baseline audit followed by rounds of audit and feedback at defined intervals. In some settings audit and feedback was provided in combination with financial incentives. Audit and feedback was found to be positively associated with childhood immunization with the effect estimate ranging from 17% absolute decrease to 49% increase. However, the exact magnitude could not be ascertained due to the limited number of low quality

| Table 1 Components of district level interventions |
| Governance and accountability: Any systematic approach to ensure that services are accountable for delivering quality healthcare including audit and feedback mechanisms, medical registries, and continuous quality improvement tools. |
| Leadership and supervision: Supervision is provision of monitoring, guidance and feedback on matters of personal, professional and educational development in the context of the patient care. Good leadership involves strategic planning for the provision of services, resource allocation, and set priorities for improved performance. |
| Financial strategy: It involves provision of monetary benefits as a source of motivation for performing desired health related actions. Financial incentives can be user- as well as provider-directed. |
| Information systems: It refers to a system that captures, manages and transmits information related to the health of individuals or the activities of organizations. Two emerging components of the information systems are the electronic health records and electronic communications. Electronic health record is the provision and access to electronically retrievable health records at the point of healthcare delivery while electronic communication involves computerized communication, telephone follow-up and counseling, interactive telephone systems, after-hours telephone access, and telephone screening. |
Table 2 Characteristics of the reviews included for governance and accountability

| Reviews (n=14) | Description of included interventions | Type of studies included (number) | Targeted health care providers | Outcome reported | Pooled data (Y/N) | Results |
|----------------|--------------------------------------|----------------------------------|-------------------------------|------------------|-------------------|---------|
| Bordley 2000 [22] | Audit and feedback was defined as any summary of clinical performance gathered over a defined period of time and presented to the health care provider after collection. | ITS: 6, RCT: 5, Pre-post: 4 | Health care professionals | Immunization rate | No | 17% absolute decrease to 49% increase |
| Grimshaw 2004 [23] | Audit and feedback: any summary of clinical performance of healthcare over a specified period. | C-RCTs: 110, P-RCTs: 29, C-CCTs: 7, PCCT: 10, CBAs: 40, ITS: 39 | Health care professionals | Performance improvement | No | Absolute improvement of +7.0% (range +1.3 to +16.0%) (dichot process measures) |
| Hulschur 2001 [24] | Feedback: provision of a summary of clinical performance after the performance concerned, based on medical records, computerized databases or other sources of information. | 55 studies, RCTs: 37, nRCTs: 18 | Primary care professionals directly accessible to patients for all types of health problems in US | Preventive services | No | Absolute increase of 3% to 26% |
| Ivers 2012 [35] | Audit and feedback defined as any summary of clinical performance over a specified period of time | RCT: 49 | Health care provider (excluding students) | Compliance | Yes | 4.3% absolute increase in healthcare professionals' compliance with desired practice (dichot) |

0.8 more visits

1.3% absolute increase in healthcare professionals' compliance with desired practice (cont)
Table 2 Characteristics of the reviews included for governance and accountability (Continued)

| Author          | Year | Title                                                                 | Study Design | Population | Intervention                                                                 | Outcome | Methodology                                                                 |
|-----------------|------|----------------------------------------------------------------------|--------------|------------|-------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------|
| Jamtvedt        | 2006 | Audit and feedback defined as any summary of clinical performance over a specified period of time | RCT: 118     | Health care provider (excluding students)                                     | Compliance | No median-adjusted risk difference was 5% (range 3–11) (dichot)              |
|                 |      |                                                                      |              |            |                                                                                |         | median-adjusted percentage change relative to control was 16% (5–37)        |
| Jepson          | 2000 | Audit and feedback to physicians on their performance, and sometimes that of their peers | 05 studies: 05 studies: RCTs: 02 quasi-RCT: 01 Controlled trials: 02 | All people eligible to participate in a screening programs as defined by the entry criteria for that programs, included population groups such as pregnant women, neonates, children and adults in US | Screening Uptake | No One trial: no effect on screening for occult blood                        |
|                 |      |                                                                      |              |            |                                                                                |         | One trial and one quasi: feedback more effective on some tests              |
|                 |      |                                                                      |              |            |                                                                                |         | Two trials: increased uptake of mammograms (p<0.05)                         |
| Johnston        | 2000 | Clinical and Medical Audit mechanisms                                 | Total Studies: 93 | All health professionals, mostly in UK                                      | Clinician’s perceptions of benefits and disadvantages of audit Barriers and facilitators of audits | No Narrative |                                                                      |
| Oxman           | 1995 | Audit and feedback: Any summary of clinical performance of health care over a specified period, with or without recommendations for clinical action. | Total: 31 | Health care provider (excluding students) in mixed country setting | Rate of prescription for generic drugs | No | 40% increase in rate of prescription                                        |
| Pattinson       | 2005 | Any form of audit and feedback with any other clearly defined form of audit or feedback or control group | No studies | Maternity units | Time and costs Perinatal and maternal mortality and morbidity rates | No | No studies found                                                               |
| Phillips        | 2010 | Clinical governance is a systematic and integrated approach for ensuring services is accountable for delivering quality health care. Clinical governance is delivered through a combination of strategies including: ensuring clinical competence, clinical audit, patient involvement, education and training, risk management, use of information, and staff management. | RCTs: 7, longitudinal observational: 11 Case study: 1 | Primary health care providers in HIC | Process measures | No Narrative |                                                                      |
design studies [22]. For the screening uptake, feedback resulted in higher proportion of physicians with completed mammograms and it was most effective when targeting test ordering and prevention activities, and when associated with low baseline adherence to recommended care or more intense feedback [26]. A review evaluating the effectiveness of maternity ward audits did not find any trial for inclusion but reported that serial data suggests benefit [29].

For outcomes other than MNH, audit and feedback was found to improve health care workers performance and compliance with desired practice by 7% and 4.3% respectively [23,35]. It was also associated with 40% increase in rate of prescription for generic drugs [28]. Feedback involved verbal, written or both provided either by the supervisor, professional standards review organization or employer representative. Majority of the feedback provided included action plans or correct solution information with the feedback. Some of the reported factors influencing audit and feedback included problems with staff coordination, lack of strong evidence base for some topics, poor access to published work and high-quality clinical data, organizational factors and lack of time and motivation [32,33].
Leadership and supervision

We included seven [28,36-41] reviews evaluating the impact of leadership and supervision with a median quality score of 8 on AMSTAR criteria. Included reviews focused on the impact of leadership and supervision for the primary health workers [36,37]; involvement of local community leaders [38], nursing leadership [39,41] and supervising counselors or psychotherapist [40]. Due to the wide range of reported outcomes, data could not be pooled for any outcome except for compliance in one review evaluating the impact of involving opinion leaders [38]. None of the reviews reported outcomes specific to MNH while other reported outcomes included compliance, patient satisfaction, provider’s practice and knowledge. The evidence was from both LMIC and HIC. The characteristics and findings of the included reviews are presented in Table 3.

Involving local opinion leaders to promote evidence-based practice resulted in a 12% [RD: 12%, 95% CI: 6-14.5%] absolute increase in compliance with the desired practice [38]. These opinion leaders were identified using the sociometric method in which healthcare professionals were asked to complete a self-administered questionnaire to identify educationally influential colleagues. Once identified, they were involved in informal or formal teaching through one to one teaching, community outreach education visits, small group teaching, preceptorships and delivering. Involving local opinion leaders was found comparable to other strategies used to disseminate and implement evidence based practice in health care including distribution of educational materials, audit and feedback and educational outreach. Another review based on a single RCT demonstrated a substantial increase in the number of trials of vaginal delivery after previous cesarean section in hospitals with the involvement of local opinion leaders [28]. The impact of supervision on the quality of primary health care in LMIC was inconclusive due to low quality studies [37]. Nursing leadership and supervision suggested improvements in patient satisfaction and reduction of adverse events; however, the evidence is inconclusive for complications and mortality rates [39,41].

Financial strategy

We included 10 [12,42-50] reviews and 1 [11] overview of reviews with median data quality score of 8.5 on AMSTAR criteria. Six reviews evaluated provider-
directed incentives in the form of pay for performance, economic incentives, results based financing (RBF); while others focused on user-directed incentives including CCTs, vouchers, health insurance or user fee exemption. Seven reviews reported outcomes specific to MNH while meta-analysis was conducted in only two of the reviews [42,50]. Reported MNH outcomes included immunization coverage, service utilization, institutional delivery, antenatal care (ANC), post natal care (PNC), skilled birth attendant, child nutritional status and anthropometry while other reported outcomes were consultation rates, compliance, prescription rates, referrals and hospital/Emergency Department (ED) visits. Most of the reviews were from LMIC. The characteristics and findings of the included reviews are presented in Table 4.

Among user directed financial strategies, CCT demonstrated significant improvements in preventive clinic visits (RR: 1.26, 95% CI: 1.09, 1.45), Diphtheria, pertussis and tetanus (DPT) immunization (RR: 1.08, 95% CI: 1.03, 1.14), health service utilization, child nutritional status and health outcomes [42,45] with non-significant impacts on full immunization, stunting and wasting [42]. An unpublished review on the impact of a range of financial platforms on MNH reported significant overall impact on maternal health indicators with maternal voucher schemes (RR: 2.97, 95% CI:2.38-3.71), user fee exemption (RR: 1.57, 95% CI: 1.33-1.85) and community based health insurance (RR: 1.77, 95% CI: 1.29-2.44) while CCTs and national health insurance (NHI) did not show any significant impacts [50]. Maternal voucher schemes were reported to be the most effective strategy.
| Reviews (n=11) | Description of included interventions | Type of studies included (no) | Targeted health care providers | Outcome reported* | Pooled data (Y/N) | Results               |
|---------------|----------------------------------------|-------------------------------|---------------------------------|-------------------|-------------------|----------------------|
| Flodgren 2011 [11] (overview) | An incentive is any factor (financial or non-financial) that provides motivation for a particular course of action, or counts as a reason for preferring one choice compared to alternatives. Financial incentives are extrinsic sources of motivation and exist when an individual receives a monetary transfer which is made conditional on acting in a particular way | 4 reviews | physicians, dentists, nurses, and allied healthcare professions (such as physiotherapists, speech therapists etc.) involved in providing direct patient care in LMIC and HIC | Consultation or visit rates | No | Improvement in 10/17 outcomes |
| Gaarder 2010 [42] | The traditional CCT programs (which is how we will refer to the nine safety-net type of programs included in the study) were specifically designed to influence demand-side factors, and, in most cases, not the supply-side factors | 41 studies related to 11 programs/ interventions | General population | Clinic visits | Yes | 1.26 (1.09, 1.45) |
| Giuffrida 1999 [43] | Target payments remuneration. Under a target payments remuneration system a lump sum payment is made if, and only if, the PCP reaches a predetermined quantity or target level of care. | RCT: 1 ITS: 1 | Primary Care Physicians (PCPs) defined as medically qualified physicians who provide primary health care. | Immunization rates | No | Significant improvement in 1 of 2 studies |
Table 4 Characteristics of the reviews included for Financial Platforms (Continued)

| Gosden 2000 | Salary: where a lump sum payment is made to the PCP for a set number of working hours or sessions per week. |
|-------------|-------------------------------------------------------------------------------------------------|
|            | **Capitation** where a payment is made to a PCP for every patient for whom they provide care. |
|            | **Fee-for-service (FFS):** where payment is made to a PCP for every item of service or unit of care that they provide. |
| Lagarde 2007 | Effect of directly transferring money to households conditional on some requirements, at least 1 of which had to be related to health seeking behavior. |
| Lagarde 2009 | Direct monetary transfers made to households and transfers conditioned on a particular behavior or action (e.g. visit to a health facility for regular checkups). Unconditional transfers were not considered. |

| Gosden 2000 | RCTs: 2, BFA: 2 | Primary Care Physicians in HIC | No | Narrative |
|-------------|-----------------|-------------------------------|----|-----------|
| Lagarde 2007 | Total: 10, RCTs: 04, quasi-randomized trial: 01 controlled before-and-after study: 1 | People living in low- or middle-income countries, as defined by the World Bank. Health services and institutions in LMIC | Care seeking behavior | Immunization coverage | No | 3/5 studies showed significant improvement in at least 1 of the care seeking outcome |
| Lagarde 2009 | RCT’s: 08, controlled before after (CBA) studies: 02 | People living in low- or middle-income countries, as defined by the World Bank. Health services and institutions | Health service utilization | No | 27% increase in individuals returning for voluntary HIV counselling, 2.1 more visits per day to health facilities |

Prescriptions
Diagnosis and curative services
Referrals
Health/ Emergency department visits
Hospitalization
Compliance
Costs

Anthropometric and nutritional

3/4 studies reported significant improvement. All programs showed positive outcome.

Immunization coverage

11-20% more children taken to the health center
23-33% more children <4 yrs. attending preventive healthcare visits
3/4 showed improvement (insignificant)
| Study            | RBF Definition                                                                                                                                                                                                 | Target Population                                                                 | Outcome                          |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------|
| Oxman 2009       | RBF can be defined as the transfer of money or material goods conditional on taking a measurable action or achieving a predetermined performance target.                                                                 | Recipients of healthcare, individual providers of healthcare, healthcare facilities, private sector organizations, public sector organizations, sub-national governments (municipalities or provinces), national governments, or multiple levels in LMIC. | 22-25% decrease in the probability of children <3 years old being reported ill in the past month. |
| Scott 2011       | Financial incentives defined in detail in terms of method of payment, level of payment. Quality of care defined broadly as the degree to which health care services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge. | Primary care physicians (PCPs) defined as doctors holding A medical degree and include general practitioners, family doctors, family physicians, family practitioners, and other generalist physicians working in primary healthcare settings who fulfill primary health care tasks. | 6/7 studies showed modest positive effects on quality of care for some primary outcome measures, but not all. One study found no effect on quality of care. |
| Town 2005        | The term “economic incentives” describes financial incentives where there is an increase in physician income that is a function of measurable performance criteria. These include bonus payments payable on the basis of number of specific services provided, or based on the provider achieving a target outcome or target behavior. | Physician in US Preventive services. | 1/6 studies reported significant improvement. |
| Witter 2012      | Pay for performance refers to the transfer of money or material goods conditional on taking a measurable action or achieving a predetermined performance target.                                                                 | Primary care physicians and facilities, sub-national organizations (health administrations, non-governmental organizations or local governments), national governments and combinations of these in LMIC. | Mixed findings from 5 studies. Both positive and negative impacts in 2 studies. |
Table 4 Characteristics of the reviews included for Financial Platforms (Continued)

| Financing platforms | Patient outcome | Maternal Voucher Schemes: |
|---------------------|----------------|--------------------------|
| Zaidi 12 (unpublished) [50] | Yes | | 2.97 (2.38-3.71) |

| Utilization of service (antenatal care) | Mixed findings from 4 studies |
|---------------------------------------|-------------------------------|
| Utilization of service (institutional delivery) | No impact on preventive care |
| Utilization of service (preventive care for children) | Immunization coverage improved in 4/4 studies |
| Patient outcome | Improved wasting in 1/1 study |

Financing platforms that addressed maternal care either as primary objective of their study or as part of a larger service package. Types of financing strategies considered for this review included cash transfers, vouchers, contracting, community health insurance schemes, national health insurance, and user fee exemption.

| Institutional delivery | 3.70 (2.03-6.73) |
| Skilled birth attendant | 3.81 (2.92-4.95) |
| Complicated delivery | 1.53 (1.14-2.05) |
| ANC | 3.08 (2.23-4.25) |
| PNC | 2.66 (1.59-4.44) |
| Maternal CCT: | 0.88 (0.76-1.02) |
| Skilled birth attendant | 0.88 (0.76-1.02) |
| User fee removal: | 1.57 (1.33-1.85) |
| Institutional delivery | 1.58 (1.16-2.14) |
| Skilled birth attendant | 1.54 (1.26-1.88) |
| National health insurance: | 1.22 (0.90-1.65) |
| ANC | 1.04 (1.01-1.07) |
| Institutional delivery | 1.48 (0.79-2.78) |
| Community based health insurance: | 1.77 (1.29-2.44) |
| Institutional delivery | 3.00 (1.60-5.61) |
| ANC | 1.41 (1.22-1.63) |
| PNC | 0.96 (0.46-2.00) |
and demonstrated significant improvements across all range of outcomes including institutional delivery (RR: 3.7, 95% CI: 2.03, 6.73), skilled birth attendance (RR: 3.81, 95% CI: 2.92, 4.95), complicated delivery (RR: 1.53, 95% CI: 1.14, 2.05), ANC (RR: 3.08, 95% CI: 2.23, 4.25) and PNC (RR: 2.66, 95% CI: 1.59, 4.44) [50].

Among provider-directed financial strategies, target payments to primary care physicians (PCP) and pay-for performance showed positive trends for immunization rates [43] while the findings were inconclusive for provider performance, service utilization, compliance or quality of primary health care [11,43,47,49]. We did not find any evidence for the impact on patient outcomes.

**Information systems**

We included fifteen [19,51-65] reviews pertaining to computerized communication, electronic health record system, telephone follow-up and counseling, interactive telephone systems, after-hours telephone access and telephone screening. The quality of included reviews ranged from 3 to 10 on AMSTAR criteria. Reported MNH outcomes included immunization rates, mammography uptake, and newborn health outcomes [51,64] while other reported outcomes included technology adoption, patient satisfaction, professional behavior and knowledge. All the reviews were from HIC only. The characteristics and findings of the included reviews are presented in Table 5.

Distance communication significantly improved immunization rates (Range: 6.4%-27.2%) and number of mammograms (Range: 14%-25%) [51] with non-conclusive evidence on the use of telemedicine to support parents of high-risk newborns receiving intensive care [64]. Distance medicine technology also reported greater continuity of care by improving access and it should not be limited to physician-to-physician communication only [51]. Evidence also suggests that telephone consultation might reduce the number of surgery contacts and out-of-hours visits by general practitioners [53,54]. All the technological aspects of the interventions were reported to be well accepted by patients with some evidence of clinical benefits [56].

There is very limited evidence on interventions to promote information communication technologies (ICT), improvements in knowledge about the electronic sources of information and use of electronic databases and digital libraries by healthcare professionals [61,65]. Studies examining physician use of electronic records found mostly neutral or mildly positive effects on patient satisfaction (3.7%, 95% CI: 2.9-5.2%) [60] while computer based guideline implementation resulted in improved adherence [63]. No change in professional behavior was reported following electronic retrieval of health information.

**Discussion**

At district level, audit and feedback mechanisms can effectively improve immunization rates; healthcare worker performance and compliance with desired practice; and prescription rates for generic drugs. Generalizability of these findings are however limited to HIC only. Involving local opinion leaders in informal/formal teaching, preceptor-ship and evidence based intervention dissemination can improve compliance with the desired practice. User-directed financial incentives have the potential to improve MNH outcomes, with CCT and maternal voucher schemes having the most significant positive impact across a range of outcomes. These findings are generalizable to both HIC and LMIC. There was limited and inconclusive evidence on the effectiveness of information technology

| Reviews (n=15) | Description of included interventions | Type of Studies included (no) | Targeted Health care Providers | Outcome reported | Pooled Data (Y/N) | Results |
|---------------|--------------------------------------|------------------------------|-------------------------------|------------------|-------------------|---------|
| Black 2011 [52] | The researchers divided e-Health technologies into three main categories: (1) storing, managing, and transmission of data; (2) clinical decision support; and (3) facilitating care from a distance. | 53 systematic reviews | Various health care professionals | Patient outcomes | Electronic prescribing | No | Weak to moderate effect (10 out of a total of 26 studies) |
| | | | | | Associated computerised provider (or physician) order entry systems | 6 out of a total of 6 studies showed no benefit |
| Reviewer          | Type of intervention                                                                 | Setting                                                                 | Measure                          | Effect Size                  |
|-------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------|------------------------------|
| Gagnon 09 [65]    | Any type of intervention to promote the adoption and use of any type of Information Communication Technology (ICT) (electronic medical record, telemedicine/tele-health, health information networks, decision support tools, Internet-based technologies and services). | Healthcare professionals, residents, fellows, and other registered healthcare professionals in HIC | Information and communication technology adoption | No Small to moderate positive effect on adoption (4/10) |
| Hayrinen 08 [58]  | Electronic health records: definitions, structure, context, access, purpose and methods | 89 papers Health care professionals in HIC | Electronic health records: definitions, structure, context, access, purpose and methods | No Narrative |
| Irani 09 [60]     | Use of Electronic health record system in outpatient and office setting                | Cross-sectional: 03 Pre-post: 04 (meta-analyzed: 03) Physicians in HIC | Patient satisfaction            | Yes 3.7% (2.9-5.2%) |
| McGowan 09 [61]   | Provision and access to electronically retrievable health records at point of healthcare delivery and training component | cRCT’s: 02 Physicians, nurses and midwives in HIC | Professional behavior          | No No significant change (2/2) |
| Balls 1997        | Distance technology applications were described in 6 categories: computerized communication, telephone follow-up and counseling, telephone reminders, interactive telephone systems, after-hours telephone access, and telephone screening. | 80 clinical trials General healthcare providers | Computerized communication: Clinical outcomes for diabetes, Alzheimer’s and cardiac diseases | No HbA1c decreased (4/4) Insignificant changes in other outcomes |

- **Gagnon 09**: Any type of intervention to promote the adoption and use of any type of Information Communication Technology (ICT) (electronic medical record, telemedicine/tele-health, health information networks, decision support tools, Internet-based technologies and services).
- **Hayrinen 08**: Electronic health records: definitions, structure, context, access, purpose and methods.
- **Irani 09**: Use of Electronic health record system in outpatient and office setting.
- **McGowan 09**: Provision and access to electronically retrievable health records at point of healthcare delivery and training component.
- **Balls 1997**: Distance technology applications were described in 6 categories: computerized communication, telephone follow-up and counseling, telephone reminders, interactive telephone systems, after-hours telephone access, and telephone screening.
Table 5 Characteristics of the reviews included for Information System (Continued)

| Healthcare Area         | Improvement/Significance |
|-------------------------|--------------------------|
| Osteoarthritis          | Significant improvement in AIMS score |
| Tobacco use prevention  | Significant decrease of 8.3% |
| Appointment keeping rates | Appointment kept or responsibly cancelled (5/6) |
| Immunization rates      | Significant increase (Range: 6.4%-27.2%) |
| Medication compliance   | Significant improvement in compliance events and pharmacy score |
| Diabetic foot care      | Significant improvement in serious foot lesions, dry or cracked skin, ingrown toenails and fungal nail infections |
| Osteoarthritis          | Significant improvement in physical disability and pain |

**Bunn 04/ Bunn 05 (tele consultation) [53,54]**

| All designated telephone consultation systems where patients calls are received, assessed and managed by giving advice or by referral to a more appropriate service. This included those with and without computer based clinical decision support systems | RCT: 05, CCT: 01, ITS: 03 | healthcare providers in HIC | Visit to GP's | No | Significant reduction (3/5) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------|---------------|----|----------------------------|
| Visits to A&E department | No difference (6/7), significant increase (1/7) |
| Hospital admissions | Reduction in hospital admissions (2/2) |
| Home visit | No significant reduction (1/1) |
| Out of hours contact | Small significant increase (1/2) |
| Patient satisfaction |  |
| Cost |  |

**Car 11 [55]**

| Online health literacy | RCT: 01, CBA: 01 | All patients/consumers | Self-efficacy for health information seeking | No | 1.10 points higher in intervention group |
|------------------------|------------------|------------------------|---------------------------------------------|----|----------------------------------------|
| Health information evaluation skills | 0.60 points higher in intervention group |
| # of times pt. discussed online | 0.7 times higher in intervention group |
## Table 5 Characteristics of the reviews included for Information System (Continued)

| Study | Type of Intervention | Characteristics | Outcome Measures | Findings |
|-------|----------------------|-----------------|-----------------|----------|
| Currell 00 (telemedicine) [56] | Studies which compare the provision of patient care face to face with care given using telecommunications technologies, in which at least two communication media are used interactively (e.g. video consultation between hospital consultant and general practitioner). | Trials: 07 Qualified healthcare practitioners from any discipline in HIC | Measurable difference in outcome of care | No No unequivocal benefit (7/7) |
| Grilli 02 | Mass media ITS: 20 | Healthcare providers patients and general public | Effectiveness | No Effective in improving healthcare utilization (7/7 studies) |
| Heselmans 09 [59] | An electronic guideline implementation method was defined as an electronic system directly supporting evidence-based clinical decision making in which point-of-care advice is provided based on one or more CPGs | 20 cRCT, 1 CCT, 2 CBA physicians | Patient outcomes | No 7/23 studies had >50% of the process outcomes significantly improved |
| Mistiaen 06 (telephone follow-ups) [62] | Telephone follow-up (TFU) initiated by a hospital-based health professional (medical, nursing, social work, pharmaceutical) to a patient who is discharged to his/her own home setting (including a relative’s home). | 33 RCT’s and controlled trials hospital based healthcare professional in HIC | Compliance in cardiac surgery patients | 1.68 [0.59, 4.78] |
| | | | Compliance in ED patients (making an appointment) | 1.68 [0.59, 4.78] |
| | | | Compliance in ED patients (keeping an appointment) | 1.58 [1.01, 2.48] |
| | | | Effect on knowledge in cardiac patients | 1.44 [-0.25, 3.13] |
| | | | Effect on readmission(cardiac patients) | 0.75 [0.41, 1.36] |
| | | | Effect on readmission in surgery patients | 0.65 [0.28, 1.55] |
| | | | ED visits in surgery patients | 1.47 [0.85, 2.53] |
with some positive impacts of distance communication on immunization rates and screening uptake. Evidence for structured interventions requiring electronic technologies are mainly evaluated in HIC settings hence limiting the generalizability of these findings to HIC only. This might be attributable to the gaps in access to and simultaneous underutilization of the existing electronic information resources in LMIC. Likewise, even within HIC, inequity exists in online information access between professionals in rural versus urban health settings.

There is a dearth of evidence from MNH perspectives in some domains of the district level inputs. Although financial incentives have been widely evaluated for their effectiveness in improving MNH outcomes; audits, feedbacks and information systems are mostly evaluated for general health outcomes. Furthermore, it is challenging to systematically measure and analyze data for subjective outcomes like patient/provider satisfaction and other process indicators. Reviews focusing on MNH specific interventions like maternal and perinatal mortality audits report lack of data to evaluate their effectiveness. There is also lack of qualitative data describing the individual components of the intervention for reproducibility since most of the interventions are not uniform but rather a range of approaches. For example, studies have not reported on the optimal format and frequency of audit and feedback [22]; supervision was also reported to be implemented in various ways with uncertain follow up periods [36,37].

Most of the district level interventions require a pre-existing primary health care service infrastructure and measures to ensure sustainability hence the major challenge is to ensure adequate political, financial, human and material commitments; optimal use of available resources; utilization of advanced technologies, changing management techniques including decentralization; measures to ensure accountability and effective community participation and intersectoral collaboration [66]. Hence it requires involvement of several stakeholders including policy makers, program managers and service providers from government organizations, private organizations, health development partners, technical assistance agencies, district directors and service providers. State leaders and key actors in the health sectors in LMIC along with the international community are proposed to translate the lessons learnt into actions and intensify efforts in order to achieve the goals set for MNH [67]. In LMIC, district health systems are still deprived of sustained policy attention and resources that it deserves, although more recently various forms of public private partnerships to improve MNH have emerged in LMIC whereby private organizations provide financial and technical support to refurbish and enhance the health services provided by the public sector but they are not formally evaluated for its impact.

Focus on basic primary health care interventions at the district level to improve coverage of effective public health interventions will help direct the attention towards essential preventive and promotive interventions and commodities required to deliver quality care to mothers and newborns [68]. Interventions like maternal and perinatal mortality audits and distance communication should be evaluated for effectiveness in improving MNH outcomes at the district level. Successfully implemented programs based on financial incentives to improve maternal and child health outcomes from Africa and Latin America can be simulated in other LMIC [12,50]. For these strategies to be more effective, it must be part of appropriate package of interventions, and technical

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**Table 5 Characteristics of the reviews included for Information System (Continued)**

| Study | Title | No. of Projects | Setting | Accessing emergency obstetric care, improving the capacity of lesser trained health workers, empowering women | No. of Supporting Evidence | Narrative |
|-------|-------|----------------|---------|---------------------------------------------------------------------|-----------------------------|-------------------------|
| Noordam 11 [19] | The potential of mobile phones to improve maternal health services in Low and Middle Income Countries | Projects | LMIC | No | Improved in 14 of 18 studies |
| Shiffman 99 [63] | Computer based guideline implementation | RCT: 9, NRCT: 01 time series 10, clinicians and other information providers in HIC | Guideline adherence | No | Improved in 4 of 4 studies |
| Tan 12 (telemedicine) [64] | Telemedicine technology focused on education and support to the parents or caretakers of newborn infants receiving intensive care | 1 RCT NICU staff in Indonesia | Length of hospital stay | Yes | -2.10 (-18.85-14.65) |
capacity or support must be available. Programs integrating multiple interventions have shown maximum benefits on MNH outcomes as there is no single magic bullet intervention for reducing maternal and neonatal mortality [67]. These packages should then be monitored for possible unintended effects and evaluated using rigorous study designs to identify the best possible combination of the strategies tailored to the need of the district.

Author contributions
All authors contributed to the process and writing of the manuscript.

Peer review
Peer review reports are included in Additional file 1.

Additional material
Additional file 1:

Abbreviations
ANC: Antenatal care; AMSTAR: Assessment of Multiple Systematic Reviews; CCT: Conditional Cash Transfers; CI: Confidence Interval; CQI: Continuous Quality Improvement; ED: Emergency Department; FFS: Fee for Service; HIC: High Income Countries; ICT: Information Communication Technology; IMCI: Integrated Management of Childhood Illnesses; LMIC: Low Middle Income Countries; MD: Mean Difference; MNH: Maternal Newborn; NHI: National Health Insurance; PCP: Primary Care Physicians; PNC: Postnatal Care; RBF: Result Based Financing; RD: Rate Difference; RR: Relative Risk.

Competing interests
We do not have any financial or non-financial competing interests for this review.

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References
1. Lassi et al. Paper 2: Evidence from community level inputs to improve quality of care for maternal and newborn health: Interventions and Findings.
2. Grimshaw JM, Shirani L, Thomas R, Mowatt G, Fraser C, Bero L, Grilli R, Harvey E, Oxman A, O’Brien MA. Changing provider behavior: an overview of systematic reviews of interventions. Med Care 2001, 39(8 Suppl 2):II-42-45.
3. Jamiqveld G, Young JM, Kristoffersen DT, O’Brien MA, Oxman AD. Audit and feedback: effects on professional practice and health care outcomes. Cochrane Database Syst Rev 2006, 2(2):CD000259.
4. Goppe N. Mentoring and supervision in healthcare. Sage Publications; 2011.
5. McMahon R, Barton E, Piot M. On being in charge. A guide to management in primary health care. Geneva: WHO; 2 1992.
6. Fathallut D, Piot M, Franklin A. The supervision of health personnel at district level. Geneva: World Health Organization; 1988.
7. Jasper M, Jumaa M. Effective healthcare leadership. John Wiley & Sons; 2008.
8. Klecickowski BM, Elling RH, Smith DL. Health system support for primary health care. A study based on the technical discussions held during the thirty-fourth World Health Assembly, 1981. Public Health Papers 1984, 80:1-104.
9. Grol R, Grimshaw J. Evidence-based implementation of evidence-based medicine. Jt Comm J Qual Improv 1999, 25(10):503-513.
10. Rogers EM. New product adoption and diffusion. Journal of Consumer Research 1976, 2:290-301.
11. Hodgson G, Eccles MP, Shepperd S, Scott A, Parmelli E, Beyer FR. An overview of reviews evaluating the effectiveness of financial incentives in changing healthcare professional behaviours and patient outcomes. Cochrane Database Syst Rev 2011, 7(7):CD009255.
12. Lagarde M, Haines A, Palmer N. Conditional cash transfers for improving uptake of health interventions in low-and middle-income countries. MJA 2007, 298(16):1900-1910.
13. Lim SS, Dandona L, Hoisington JA, James SL, Hogan MC, Gakidou E. India’s Janani Suraksha Yojana, a conditional cash transfer programme to increase births in health facilities: an impact evaluation. Lancet 2010, 375(9730):2009-2023.
14. World Health Organization. Strengthening Health Systems to Improve Health Outcomes: WHO’s Framework for Action. Geneva: World Health Organization; 2007.
15. MAMA-Mobile Alliance for Maternal Action. Program Website: [http://mobilemamaalliance.org/], 2013, Accessed September 3.
16. Bhutta ZA, Lassi ZS, Blanc A, Donnay F. Linkages among reproductive health, maternal health, and perinatal outcomes. Seminars in perinatology Elsevier; 2010, 434-445.
17. Leveraging mobile technologies to promote maternal & newborn health: The current landscape & opportunities for advancement in low-resource settings. Center for Innovation & Technology in Public Health. mHealth Alliance 2012, http://www.healthunbound.org/sites/default/files/uploads/leveraging_mobile_technologies_to_promote_maternal_newborn_health.pdf Accessed Sept. 2, 2013.
18. Michael PN. MoTECH: mHealth Ethnography Report. Dodawa Health Research Center for The Grameen Foundation Washington DC, 2009. Available at: http://www.grameenfoundation.uploads/Grameen_Foundation_FinalReport_3_.pdf.
19. Noordam AC, Kuepper BM, Stekelenburg J, Milan A. Improvement of maternal health services through the use of mobile phones. Tropical Medicine & International Health 2011, 16(5):622-626.
20. Austin A, et al. Paper 1: Approaches to Improve Quality of Maternal and Newborn Health Care: An Overview of the Evidence. 
21. Nandola AM, Reppner BM, Steiklenburg J, Milen A. Improvement of maternal health services through the use of mobile phones. Tropical Medicine & International Health 2011, 16(5):622-626.
22. Bordley WC, Chelensis A, Margolis PA, Kraus R, Szilagyi PG, Vann JJ. The effect of audit and feedback on immunization delivery: a systematic review. Am J Prev Med 2003, 18(4):343-350.
23. Grimshaw JM, Thomas R, MacLennan G, Fraser C, Ramsay C, Vale L, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. Health Technol Assess 2004, 8:i-71.
24. Hulscher M, Wensing M, Weijden T, Grol R. Interventions to implement prevention in primary care. Cochrane Database Syst Rev 2001, 2(2):CD000362.
25. Jamiqveld G, Young JM, Kristoffersen DT, O’Brien MA, Oxman AD. Does telling people what they have been doing change what they do? A systematic review of the effects of audit and feedback. Qual Saf Health Care 2006, 15(6):433-436.
26. Jepson R, Clegg A, Forbes C, Lewis R, Sowden A, Kleijnen J. The determinants of screening uptake and interventions for increasing uptake: a systematic review. Health Technol Assess 2000, 4(14):1-133.
27. Johnston G, Crombie IK, Alder EM, Davies HTO, Millard A. Reviewing audit: barriers and facilitating factors for effective clinical audit. Quality Health Care 2003, 12(1):23-36.

28. Oxman AD, Thomson MA, Davis DA, Haynes RB. No magic bullets: a systematic review of 102 trials of interventions to improve professional practice. CMAJ 1995, 153(10):1423-1431.

29. Pattinson RC, Scott I, Mihaljevic J, Oxman AD, Scott I, Slattery D. Maternal health as a human right: a systematic review of the evidence. Med J Aust 2010, 193(10):602-607.

30. Pyone T, Sorensen BL, Tellier S. Childbirth attendance strategies and their impact on maternal mortality and morbidity in low-income settings: a systematic review. Acta Obstetrica et Gynecologica Scandinavica 2009, 88(4):389-400.

31. Van Der Veer SN, De Keizer NF, Ravelli ACJ, Tenkink S, Jager KJ. Improving quality of care. A systematic review on how medical registries provide information feedback to health care providers. Int J Med Inform 2010, 79(5):305-323.

32. Wensing M, van der Weijden T, Grol R. Implementing guidelines and innovations in general practice: which interventions are effective? Br J Gen Pract 1998, 48(427):991-997.

33. Ivers N, Jamtvedt G, Flottorp S, young JM, Odgaard-Jensen J, French SD, O'Brien MA, Johansen M, Grimshaw J, Oxman AD. Audit and feedback: effects on professional practice and healthcare outcomes. Cochrane Database Syst Rev 2012, 6:CD000259.

34. Bosch-Capblanch X, Garner P. Primary health care supervision in developing countries. Trop Med Int Health 2008, 13(3):369-383.

35. Bosch-Capblanch X, Liqaut S, Garner P. Managerial supervision to improve primary health care in low-and-middle-income countries. Cochrane Database Syst Rev 2011, 9(9):CD006413.

36. Flodgren G, Pinnock C, Gaglioti G, Gattellari M, O'Brien MA, Grimshaw J, Eccles MP. Local opinion leaders: effects on professional practice and health care outcomes. Cochrane Database Syst Rev 2011, 8(8):CD001025.

37. Pearlson A, Laschinger H, Portny K, Jordan Z, Tucker D, Long L. Comprehensive systematic review of evidence on developing and sustaining nursing leadership that fosters a healthy work environment in healthcare. Int J Nurs Stud 2007, 44(5):565-586.

38. Wheeler S, Richards K. The impact of clinical supervision on counsellors and therapists, their practice and their clients. A systematic review of the literature. Counselling and Psychotherapy Research 2007, 7(1):54-65.

39. Wong CA, Cummings GG. The relationship between nursing leadership and patient outcomes: a systematic review. J Nurs Manag 2007, 15(5):508-521.

40. Gaarder MM, Glassman A, Todd JE. Conditional cash transfers and health: unpacking the causal chain. Journal of Development Effectiveness 2010, 2(1):6-50.

41. Guffrida A, Goden T, Forland F, Krisiansten IS, Serguson M, Leese B, Pedersen L, Sutton M. Target payments in primary care: effects on professional practice and health care outcomes. Cochrane Database Syst Rev 1999, 4(6):CD000389.

42. Godden T, Forland F, Krisiansten S, Sutton M, Leese B, Guffrida A, Serguson M, Pedersen L. Capitation, salary, fee-for-service and mixed systems of payment: effects on the behaviour of primary care physicians. Cochrane Database Syst Rev 2008, 3(3):CD002175.

43. Lagarde M, Haines A, Palmer N. The impact of conditional cash transfers on health outcomes and use of health services in low and middle income countries. Cochrane Database Syst Rev 2009, 4(4):CD008137.

44. Oxman AD, Fretheim A. Can paying for results help to achieve the Millennium Development Goals? Overview of the effectiveness of results-based financing. J Eval Clin Pract 2005, 11(2):70-83.

45. Scott A, Sivey P, Ak Quaikim D, Willenberg L, Naccaelas L, Furler J, Young D. The effect of financial incentives on the quality of health care provided by primary care physicians. Cochrane Database Syst Rev 2011, 9(9):CD008451.

46. Town R, Kane R, Johnson P, Butler M. Economic incentives and physicians’ delivery of preventive care: a systematic review. Am J Prev Med 2005, 28(2):234-240.

47. Witter S, Fretheim A, Kessy F, Lindahl AK. Paying for performance to improve the delivery of health interventions in low- and middle-income countries. Cochrane Database Syst Rev 2012, 2(2):CD007899.

48. Zaidi S, Sheikh S, Bhutta ZB, Salam R. Financing Support Platforms for BMoNC and CMoNC: A Global Landscape Review. 2012, (unpublished).

49. Balas EA, Jeffery F, Kupman GJ, Boren SA, Brown GD, Pinciri F, Mitchell JA. Electronic communication with patients. JAMA 1997, 278(2):152-159.

50. Bunn F, Byrne G, Kendall S. The effects of telephonic consultation and triage on healthcare use and patient satisfaction: a systematic review. Br J Gen Pract 2005, 55(521):956.

51. Balas EA, Jeffery F, Kupman GJ, Boren SA, Brown GD, Pinciri F, Mitchell JA. Electronic communication with patients. JAMA 1997, 278(2):152-159.

52. Black AD, Car J, Pagliari C, Andanand C, Crosswell B, Kokeun T, McKinstry B, Proctor R, Majued A, Sheikh A. The impact of e-health on the quality and safety of health care: a systematic overview. PLoS Med 2011, 8(11) e1000837.

53. Bunn F, Byrne G, Kendall S. The effects of telephonic consultation and triage on healthcare use and patient satisfaction: a systematic review. Br J Gen Pract 2005, 55(521):956.

54. Currell R, Urquhart C, Wainwright P, Lewis R. Telemedicine versus face to face patient care: effects on professional practice and health care outcomes. Cochrane Database Syst Rev 2000, 2(2):CD002098.

55. Grilli R, Ramsay C, Inonszi S. Mass media interventions: effects on health services utilisation. Cochrane Database Syst Rev 2002, 1(1):CD000389.

56. Haynren K, Saranto K, Nykanen P. Definition, structure, content, use and impacts of electronic health records: a review of the research literature. Int J Med Inform 2008, 77(S2):291-304.

57. Heitelmans A, Van de Velde S, Doorsteele, P, Aerts G, Ramaekers D. Effectiveness of electronic guideline-based implementation systems in ambulatory care settings: a systematic review. Implement Sci 2009, 4(1)82.

58. Irani JS, Middleton JF, Marfata R, Omana ET, D’Amico F. The use of electronic health records in the exam room and patient satisfaction: a systematic review. J Am Board Fam Med 2009, 22(5):553-562.

59. McCowan JL, Grad R, Yuze P, Hennes K, Deane K, Labrecque M, Welch V, Tugwell P. Electronic retrieval of health information by healthcare providers to improve practice and patient care. Cochrane Database Syst Rev 2009, 3(3):CD004749.

60. Mistaena P, Poot E. Telephonic follow-up, initiated by a hospital-based health professional, for postdischarge problems in patients discharged from hospital to home. Cochrane Database Syst Rev 2006, 4(4):CD004510.

61. Schiffrin RA, Luw Y, Brandt CA, Cobi GJ, Computer-Based Guideline Implementation Systems A Systematic Review of Functionality and Effectiveness. Journal of the American Medical Informatics Association 1999, 6(2):104-114.

62. Tan K, Lai NM. Telemedicine for the support of parents of high risk newborn infants. Cochrane Database Syst Rev 2012, 6(6):CD005818.

63. Gagnon MP, Legare F, Labrecque M, Fremont P, Pluye P, Gagnon J, Car J, Lang B, Collode A, Um C, Majued A. Interventions for enhancing consumers’ online health literacy. Cochrane Database Syst Rev 2011, 6(6):CD007092.

64. Small MB, Huppler RB, Hauer R, Boyce MJ, Martikainen P. Systematic review of 102 trials of interventions to improve professional practice. CMAJ 1995, 153(10):1423-1431.

65. Gagnon MP, Legare F, Labrecque M, Fremont P, Pluye P, Gagnon J, Car J, Majued A, Labrecque M. Interventions for enhancing consumers’ online health literacy. Cochrane Database Syst Rev 2011, 6(6) CD007092.

66. World Health Organization. Technical Paper: Primary Health Care: 25 years after Alma-Ata. Regional Committee for the Eastern Mediterranean, Fifth Session, EMRC50/8 2003, 21-218).http://www.who.int/healthsystems/observatory/.../TechnicalPaper.pdf.

67. Nyamtema AS, Rusa AP, van Roosmalen J. Maternal health interventions in resource limited countries: a systematic review of packages, impacts and factors for change. BMC Pregnancy Childbirth 2011, 11:30.

68. Disease control priorities project. Health System Performance In Developing Countries: Management Matters. Not Just Resources. 2006. Accesses from http://www.dcp2.org/file/2/DCCP-HealthSystemPerf.pdf on 05/23/2013.

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