**Supplementary file**

**Supplementary figure 1:** Search strategy example, Embase

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| 1. | Quality improvement\* OR improvement strategy\* OR quality policy\* OR quality plan\* OR quality program\* OR quality report\* OR clinical governance OR quality leadership OR quality assurance OR quality management OR quality system OR accountability |
| 2. | HIV OR HIV-1 OR HIV-2 OR HIV infect\* AIDS OR human immunodeficiency virus OR human immuno-deficiency virus OR Human immunodeficiency virus OR human immune-deficiency virus OR acquired immunodeficiency virus OR acquired immune-deficiency virus or acquired immunodeficiency virus OR acquired immune-deficiency virus |
| 3. | Randomization OR random OR double-blind procedure OR single blind procedure OR clinical trial OR meta-analysis OR longitudinal stud\* OR follow-up OR prospective\* OR retrospective\* |
| 4. | 1 AND 2 AND 3 |

All search terms were inputted in the multi-purpose field.

**Supplementary figure 2.** Median percentage increase in outcomes across QI/QA initiatives

**Supplementary Table 1.** Summary of 29 included studies.

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| **Authors** | **Location** | **QI approach\*** | **Intervention Description** | **5 key clinical outcomes: retention, ART uptake, adherence, Viral load (VL) suppression, mortality** | **Other outcomes: Opportunistic infections (OI); acceptability to patients; acceptability to healthcare workers; cost-effectiveness; process indicators; other** | **Wider impact of intervention; long-term sustainability** | **Quality assessment score** |
| ***Peer-reviewed journal articles*** |  |  |  |  |  |  |  |
| Barker et al, 201515 | South Africa | QI learning network | URBAN SETTING: IHI's Breakthrough series approach (BTS Collaborative): model for quality improvement used to improve PMTCT programme in South Africa: identify gaps, external technical advisors worked with teams to introduce protocol changes, additional resources to support performance improvement (peer-to-peer learning model); RURAL DISTRICT-WIDE: monthly review of PMTCT process data, use of improvement teams (including clinic-based PMTCT nurses/HIV testing counsellors, data clerks, ops manage); QI mentors from support NGOs visited every other week to train and mentor to use data-driven QI methods (systems analysis and rapid cycle testing of local ideas) to close performance gaps. Context-sensitive implementation; RURAL: data-driven process-improvement approach, initial external assessment then improvement targets set, then monthly clinic visits and real-time data reports to engage clinical staff. | **ART UPTAKE:** Antenatal ART uptake increased 74-86% in Urban Subdistrict Western Cape, intrapartum ART uptake increased 43-84%; uptake of maternal nevirapine 57-96%, uptake nevirapine 15-68%. | **PROCESS INDICATORS:** 6-week PCR testing 24-68%; In Rural KwaZulu-Natal coverage of CD4 testing increased 40-97% one year following intervention; | **WIDER IMPACT:** Measured infection rate of exposed infants at 6 weeks after birth which dramatically declined to 2.6%. Proportion of HIV-exposed infants testing positive declined 7.6%-5%; In Urban Subdistrict Western Cape, postnatal HIV testing increased from 79-95%; Improvements in antenatal care <20 weeks registration, antenatal care HIV negative retesting at >=32 weeks, antenatal client initiated on ART rate, mother postnatal visit within 6 days, and numbers of infant PCR positive at 6 weeks. | 63.6% |
| Cosimi et al, 201516 | Vietnam | QI Learning Network | The "PCT (Provincial Coaching Team) model": Clinical and quality improvement coaching: Training and mentoring of staff in provincial health department and HIV clinic to provide integrated coaching in clinical HIV skills and QI to the HIV clinics in the province. The model was to build a team based on existing public-sector staff that lead to strengthening leadership and rapid spread of QI | **ART ADHERENCE:** increase in documentation of adherence 83-99% (P<0.05) at 12 months at Provincial clinic and 54-97% (p<0.05) at district clinics; **ART UPTAKE** in 30 days: increased, 52%-82% (p<0.05) and 62%-91% (p<0.05); | **OI:** Cotrimoxazole prescribed if eligible increased from 31-99% and 75-83% (provincial & district level); screened for TB 15-100% and 18-79%; **PROCESS INDICATORS:** CD4 done in last 6 months 80-94% and 72-74% |  | 77.3% |
| Kols et al, 201517 | Zambia | Combined QA and QI approach | Standards-Based Management and Recognition approach to improve the quality of HIV-related services - a "comprehensive systems approach" using assessment tools across a wide array of factors that contribute to quality of services. SBM-R relies on comprehensive and detailed assessment tools to communicate and verify compliance with recommended practices. SBM-R tools guide healthcare providers in performing essential tasks, help team assess strengths and weaknesses of service delivery, and measure a facilities progress towards meeting standards. First step, identify a team, assess current practice and identify gaps; second step training and task-shifting/workshops; third step to monitor progress. |  | **ACCEPTABILITY TO HEALTHCARE WORKERS:** Provider perceptions of work environment improved at intervention sites and declined at comparison sites. | **WIDER IMPACT:** SBM-R can have a positive impact on ART and PMTCH facilities. Facility readiness scores for ART improved on four of 8 standards at intervention sites, and one standard at comparison sites: facility readiness for PMTCT increased by 15% vs 7% at comparison sites; Provider performance improved for ART services (58-84%, p<0.01) and PMTCT services (58-73% p=0.003) with no significant change at comparison sites | 54.5% |
| Oyeledun et al, 201718 | Nigeria | QI Learning network | Breakthrough series approach - specifically exploring PMTCT and retention | **RETENTION:** No difference in retention of women at 6months postpartum in intervention and control arms (44% vs 41%; RR 1.08 95% CI: 0.78 - 1.49) |  | **WIDER IMPACT:** 71% of women seen at 6 month postpartum (43% fully retained at 6-month postpartum and no missed scheduled visits); Initiation of ARV prophylaxis among infants within 72 hours not significantly different by study arm (66.0% vs 74.7%, RR 0.95 95% CI: 0.84 - 1.07) but rates of early infant testing at 4-6 weeks were higher in intervention sites (48.8% vs 25.3% Adjusted RR 1.76 95% CI: 1.27 - 2.42) | 95.5% |
| Webster et al, 201219 | South Africa | QI Learning Network | QI methods to facilitate cross facility learning/mentorship/support. Facilities recruited into a "learning network" | **ART UPTAKE:** Monthly ART initiation increased by 185.5% and during pilot phase, monthly rate of ART initiations increased by 3.6 patients |  | **WIDER IMPACT:** Proportion of estimated need for ART met in the region increased from 35.8% to 72.4%; HIV testing increased by 301.8% | 72.7% |
| Youngleson et al, 201020 | South Africa | QI learning network | QI programme (Breakthrough Series Collaborative) for primary care sites and specialised birthing centres. | **ART UPTAKE**: PMTCT clients on ART at time of labour increased from 10-25%, antenatal AZT increased 74-86%, intrapartum AZT increased from 43-84% |  |  | 81.8% |
| Bardfield et al, 201421 | Uganda, Mozambique, Namibia, Haiti | Health system approach using QI methods | HEALTHQUAL/a capacity building model designed to improve quality of care in national health systems: 3 approaches - performance measurement, QI, and quality management programme |  | **OI:** Significant improvements in cotrimoxazole prescription rates (Namibia 86% at baseline to 93% p<0.0001; Uganda 87%-91% p<0.0018; Haiti 65%-96% p<0.0001; Mozambique unchanged) |  | 100.0% |
| Joseph et al, 201524 | Haiti | Health system approach using QI methods | HEALTHQUAL: Quality improvement intervention led by Zamni LaSante and Partners in Health in partnership with Haitian Ministry of Health to spread capacity and improve quality across a network of clinics in HIV and other targeted areas of healthcare delivery in rural Haiti. | **RETENTION:** Proportion of patients eligible for treatment being on ART increased (45-81%, p<0.01); Pregnant women on ART increased (39-79%, <0.05) - page 58/S171 |  | **WIDER IMPACT:** Quality improvement went beyond HIV care/HIV treatment to improve capacity in other areas of care. | 72.3% |
| Massoud et al, 201522 | Uganda, Mozambique, Namibia, Haiti | Health system approach using QI methods | Chronic Care Model/QI using the ART Framework: QI teams established in each of five healthcare facilities. | **RETENTION**: Over a 2-year period, gap in retention decreased from 49-24%; **ART UPTAKE:** gap in coverage decreased 44-19% | **OTHER:** wellness (defined as having a positive clinical, immunological, and/or virological response to treatment without unmanageable side-effects) gap decreased 53-14%. |  | 68.2% |
| Bazant et al, 201423 | Zambia | Standard-based methods that use QA and QI tools to improve performance gaps | The SBM-R approach: Standards-based management and recognition approach. The intervention involved on-site training, supportive supervision, and action planning focusing on detailed service delivery standards - it empowers staff to identify and address gaps between performance and standards through training, supervision, and action planning. |  | **ACCEPTABILITY OF HEALTHCARE PROVIDERS:** The performance and quality improvement intervention was associated with improvements in providers' perceptions of work environment consistent with the intervention's focus on commodities, skills acquisition, and receipt of constructive feedback. P<0.001 on perceived adequacy of drugs, supplies, feeling safe from harm, constructive feedback from supervisors and co-workers, and p<0.04 for equipment. Changes in perceived quality of care did not change between intervention and comparison group. |  | 100.0% |
| Lolekha et al, 201025 | Thailand | Health system approach using QI methods | Pediatric HIVQUAL-T – a model for performance measurement and quality improvement, adapted from USA HIVQUAL/HEALTHQUAL model by incorporating Thai national guidelines as standards. Authors conclude QI "may" be attributed to QI activities. | **ADHERENCE:** Increases in adherence monitoring 97% eligible patients -100% 2005-2007 (p=0.30); **ART UPTAKE**: 98-100 (p=0.77); | **PROCESS INDICATORS:** CD4 monitoring 97% (2005)-99%(2006)-96%(2007) (p=0.92); VL monitoring 58-39-65 (p+0.50); **OI**: Clinical TB screening 86-98-83% (p=0.52); PCP prophylaxis 86%-82%-100% (p=0.02); **OTHER:** Study also looked at QI to improve dental and eye screening. |  | 95.5% |
| Thanprasertsuk et al, 201226 | Thailand | Health system approach using QI methods | HIVQUAL-T is a process for measuring HIV care performance and quality improvement - via the establishment of a locally led QI infrastructure and process. Common improvement strategies used included the development of checklists and flow-charts for physicians. Some clinics addressed structural issues such as establishing a multidisciplinary HIV care team that met regularly to plan appropriate care for patients and linking their HIV QI teams to the hospital-wide QI committees which helped provide resources and support for HIV QI activities | **ART UPTAKE:** Percentage of eligible cases receiving CD4 testing for subsequent ARV treatment (ARV treatment for patients with CD4 200 cells/uL, or AIDS defining condition) went from 100-90% (p=0.74). **ADHERENCE:** Not measuring adherence specifically, but the percentage of patients on ART who received a CD4 test every 6 months increased from 14% in 2003 to 77% in 2008 (p<0.001) | **OI:** Percentage of eligible cases receiving *Pneumocystis jiroveci* pneumonia prophylaxis went from 94-93% (p=0.95). For TB screening 24-99% (p<0.01). Cryptococcal prophylaxis increased from 65%-94% in 2008 (p=0.049). For *P marneffe*i infection (0-32% p=0.011); **PROCESS INDICATORS:** Median percentage of patients that ever received a CD4 test increased 24-99% (P<0.001); who received a CD4 test every 6 months 14-77% (p<0.001); **OTHER:** Papanicolaou smear (0-67% p<0.001) and syphilis screening 0-94% (p<0.001). | **WIDER IMPACT:** Improved implementation of national guidelines. | 100.0% |
| Osibo et al, 201727 | Northern Nigeria | QI learning network | Focus of improving retention-in-care of pregnant women and mothers with HIV. Facility-based teams trained to implement continuous quality improvements activities including structured assessments, developing change packages and collaboration in periodic collaborative learning sessions |  | **Satisfaction:** No significant changes in patient satisfaction.  Enthusiastic participation by HCW – good attendance & active engagement.  **Process indicator:** data quality improvement over course of intervention. | Establishment of a compendium of 19 “change ideas” that could be compiled into a single package and implemented by HCW, and used to guide policy | 68.2% |
| Ngidi et al, 201328 | South Africa | QI Campaign | Implementation of a campaign among district health workers to fast-track eligible pregnant women onto ART – media publicity, staff training, accountability and reporting for those involves, simplification of current practices (14 steps down to 6) | **ART Uptake:** Monthly referrals for ART rose from 78.7 (95% CI: 68.7 to 88.7) to 188.2 (95% CI: 167.2 to 209.1).  ART monthly Initiation rose from 20.7 (95% CI: 1.6 to 39.8) to 123.8 (95% CI: 107.9 to 139.8). |  | Rapidly implemented with a prediction of a low incremental cost (no personnel were added to the health system) could make this a viable intervention in resource limited settings. | 77.3 |
| *Grey literature* |  |  |  |  |  |  |  |
| Bardfield et al, 201529 | LMICs; case study in Namibia | Health system approach using QI methods | HEALTHQUAL | **RETENTION:** increase 79% - 82%; **ART UPTAKE**: (patients eligible for ART who received ART): 83-94%; **ADHERENCE:** 90-97% |  | **WIDER IMPACT:** National quality program can lead to improvements in care and capacity development | 100.0% |
| Bardfield et al, 201230 | 13 LMIC countries | Health system approach using QI methods | HEALTHQUAL; interventions underway: (HAITI) Initiation of weekly meetings of the ART Selection Committee to discuss ARV  initiation for newly eligible patients; Adoption of a weekly strategy to search for eligible patients who may have  been overlooked using a printed list generated by the EMR; Implementation of a form to be used for prompt identification of eligible  patients to facilitate both the presentation of cases to the Selection Committee and ARV initiation for eligible patients; Email of updated National HIV Care & Treatment guidelines to all providers, previously modified to address ART enrolment eligibility based on CD4  levels. (NAMIBIA) Systematic pill counts during every pharmacy visit, Creation of an adherence record sheet attached to the patient file, Reinforcement of data reporting, Provision of ongoing adherence counselling, Outreach activities to patients in local communities, Creation of a patient pamphlet for ARV adherence translated into English, Oshiwambo and Afrikaans. | **ART UPTAKE:** Haiti - 15.8% Dec 2010 - 69.2% December 2011; **ADHERENCE:** Namibia - Improved from Feb 2007 - April 2009; |  |  | 45.5% |
| Behumbiize et al,31 | Uganda | Health system approach using QI methods | HIVQUAL/HEALTHQUAL | **ART UPTAKE:** Decreased 08-09: 82-76%; **ADHERENCE:** Decreased 82-76% but documentation of adherence assessment every 3 months increased 81%-92% | **OI:** Prophylaxis within 6 months increased 73-91%, TB screening within 6 months increased 57-96% | **LONG-TERM SUSTAINABILITY:** Authors state that few systems are in place to sustain QI initiatives. | 72.3% |
| Bijou et al, 201232 | Haiti | Health system approach using QI methods | HEALTHQUAL - Electronic medical record system 'iSante' - HEALTHQUAL International quality of care indicators incorporate to facilitate quality improvement; HEALTHQUAL Haiti indicator performance reports produced. | **ART UPTAKE:** At one hospital enrolment of eligible children into ART programme increased 12-25% | **OTHER:** Enrolment in PMTCT improved (at one hospital enrolment increased 33%-96%) |  | 63.6% |
| Broughton et al, 201433 | Nicaragua | Health system approach using QI methods | USAID Health Care Improvement Project involving organisational change (i.e. Medical records management, extending clinic operating hours etc, and psychological support changes (ie. Promotion of family support, counselling for providers etc). |  | **OI:** Risk decreased by 24% (95% CI: 14-34%); **COST-EFFECTIVENESS:** Average per-patient costs decreased by $133/patient/year (95% CI: $29 - $249) |  | 100.0% |
| HEALTHQUAL International February 2015 Data Report34 | LMICs; case study in Namibia | Health system approach using QI methods | HEALTHQUAL/Implementation of routine performance measurement | **ART UPTAKE:** Increased in Uganda, Mozambique, Namibia, Haiti, Guyana, Vietnam, Kenya p. 8; **ADHERENCE:** ART Adherence Assessment increased in Uganda, Mozambique, Namibia, Haiti, Guyana (Not Vietnam or Kenya) p. 9; Adherence rate in Haiti increased 67-72% |  |  | 81.8% |
| HEALTHQUAL International35 | Vietnam | Health system approach using QI methods | HEALTHQUAL/quality improvement in outpatient clinic | **ART UPTAKE:** increased proportion of patients eligible for ARV who start ARV within 30 days: 61-90% between January and September 2012 | **PROCESS INDICATORS:** Proportion of patient CD4 tested in past 6 months 43-78% |  | 45.5% |
| Kayita et al, 201336 | Uganda, Haiti | Health system approach using QI methods | HEALTHQUAL | **ART UPTAKE:** Uganda increase from 26-85% (paediatric ARV therapy mean %); Haiti ART access for HIV+ pregnant women mean % increased 32-86%; **ADHERENCE:** Uganda: Paediatric ART mean % for adherence increased 43-81% |  |  | 72.3% |
| Kimaro et al, 201537 | Tanzania | Health system approach using QI methods | USAID Community Health System Strengthening (CHSS) model improves the performance of community-based healthcare workers and increasing linkages between communities and health facilities to improve HIV prevention, treatment and care. | **RETENTION:** CHSS model increased retention in care of PLHIV. |  |  | 59.1% |
| Mohamed et al, 201238 | Kenya | Health system approach using QI methods | HIVQUAL/HEALTHQUAL model implemented; training, coaching, monitoring | **ADHERENCE**: Adherence assessment increased 8%-100%; | **OTHER:** Treatment failure decreased 73-44% |  | 54.5% |
| Palumbo, 201339 | 15 LMIC countries | Health system approach using QI methods | HEALTHQUAL; interventions underway: Education to reinforce screening practices and guidelines adherence, mobile teams outreach, task shifting strategies, involving expert patients, community outreach, patient guides, patient education, weekly team meetings, data systems modifications etc | **ART UPTAKE**: Uganda 76-88%, Mozambique (decreased) 80-67%, Namibia 83-86%, Haiti 45-58%, Guyana 71-76%; **ADHERENCE:** Namibia 90-97%, Uganda 63-85%, Mozambique 66-92%, Haiti 29-83%, Guyana 56-80% | **PROCESS INDICATORS**: CD4 monitoring Uganda 31-49%, Mozambique 40-37%, Namibia 74-62%, Haiti 31-30, Guyana 83-76%; **OI:** cotrimoxazole preventive therapy Uganda 88-90%, Mozambique 65-73, Namibia 86-92, Haiti 62-88, Guyana 71-78 and TB Screening Uganda 57-91, Mozambique 25-60, Namibia 81-90, Haiti 29-92, Guyana 89091. |  | 27.3% |
| Ssendiwala et al, 201340 | Uganda | Health system approach using QI methods | HEALTHQUAL | **ART UPTAKE:** ART initiation 82%-89%; **ADHERENCE:** ART adherence assessment: 72%-90% | **OI:** TB Assessment 25-90% |  | 22.7% |
| Thimothe et al, 201041 | Haiti | Health system approach using QI methods | HIVQUAL/HEALTHQUAL: a model for capacity building through coaching and mentoring to build government and facility-based quality management systems. | **ADHERENCE:** 40-86.5% (JUNE 08-JUNE 09) of patients on ART were assessed for adherence in the past month; **RETENTION:** 76.2% of participating facilities obtained an improved score in ARV retention measured at enrolment and at 6 months | **PROCESS INDICATORS:** CD4 increased 10.8-20.5% had a CD4 count measured at enrolment and at 6 months. **OI:** cotrimoxazole in HIV-positive paediatric patients increased 50-84.8% and 56-75% in adult patients; Screened for TB 21.4%-29.4%; |  | 45.5% |
| USAID ASSIST Applying Science to Strengthen and Improve Systems Project 201442 | LMICs; case study in Namibia | Health system approach using QI methods | ASSIST: improves quality by strengthening national capacity, support for improvement strategy development, strengthen productivity and performance of health-care workers, strengthen community-facility linkages etc. | **ART UPTAKE:** Tanzania PMTCT - number of HIV-positive mothers being initiated on lifelong ART increased from 43% Jan 2011 to 99% February 2014. |  |  | 59.1% |
| USAID Lessons Learned/Collaborative improvement methods Nov 201643 | LMICs; case study in Tanzania | Health system approach using QI methods | Various quality improvement methodologies - collaborative improvement methods | **ART UPTAKE:** % HIV-positive pregnant women enrolled in ART increased 81-100% (Tanzania) | **OTHER:** Loss to follow-up reduced from 7-1%; **OI**: cotrimoxazole prophylaxis in exposed children increased 12-95%, % of patients screened for TB rose 35-98%. |  | 59.1% |

\*Please refer to Figure 1 for a full description of these initiatives. PMTCT= Prevention of mother-to-child transmission. Papers were split into tertiles on the basis of quality scores, and categorised as low (22.7% - 59.1%), medium (63.6% - 72.7%), and high (77.3% - 100%) quality.