Purpose of review
HIV prevention and care is changing rapidly; guideline revisions and programmatic scale-up require innovative approaches to in-service training and care extension to improve provider practice and care access. We assessed recent (<12 months) peer-reviewed publications on electronic health (eHealth), telemedicine, and other innovative provider-targeted interventions for HIV-related care.

Recent findings
Key developments included systems merging electronic medical records (EMR) with provider clinical decision aids to prompt action, demonstration eHealth, and telemedicine projects, reviews or descriptions of technology to improve connectivity in lower resource settings, and a few trials on provider-centered interventions. Most publications were program reports and few data were available regarding efficacy of eHealth interventions for providers on patient HIV-related outcomes, notably identification and management of antiretroviral treatment failure in Kenya. Better evidence is needed for strategies to train providers and care extenders with the goal to improve impact of HIV prevention and care interventions.

Summary
Rapid technology introduction and expansion may change the paradigm for improving provider knowledge and practice. Although new, the developments are promising for HIV provider-targeted eHealth and innovations for traditional training. More rigorous testing with randomized trials is needed to demonstrate impact on services for people living with HIV.

Keywords
digital health, electronic health, healthcare provider interventions, HIV training, in-service training, mobile-phone-based interventions, telemedicine

INTRODUCTION
Continuing education and support for providers is critical in light of periodic changes in guidelines for HIV care and treatment, coupled with mandates for rapid scale-up of care [1,2]. This is particularly true in remote areas and for primary care cadres without infectious disease or HIV subspecialty training. Traditional in-service training, such as centralized workshops with ongoing support, may not be feasible in some settings; in addition, expert input may be needed urgently at times, and case acuity or other access challenges obviate the ability to refer for specialist care. These variables highlight the need for an effective strategy to build providers’ capacity.

Electronic health (eHealth), defined by the WHO as the use of information and communication technologies (ICT) for health [3], offers novel approaches to provider training, records-based clinical guidance, and proxy actions to extend care for people living with HIV (PLHIV). eHealth comprises several domains, including mobile health (mHealth), health information systems/electronic medical records (EMR), telemedicine, and eLearning, and the various formats have been utilized across different health areas in recent years. We aimed to review and synthesize recent eHealth (with particular focus on telemedicine) and other approaches to provider training and client care improvement for HIV with a critical
HIV and new technologies

KEY POINTS

- There are few randomized controlled trials for eHealth or telemedicine interventions targeting providers for HIV care-related outcomes; articles describing study protocols indicate future trials are planned.
- EMR platforms should merge with software programs to provide alerts and clinical guidance to improve knowledge and quality of care for HIV and other fields. EMR system design must include compatibility with other electronic systems with no proprietary barriers to ensure interoperability.
- As strategies for eHealth and telemedicine provider training become more robust, it is essential to determine standards for in-service training and follow-up support for HIV care providers. This requires better-quality evidence for definitions and best continuing education practices.

analysis of gaps in the literature and recommendations for potential next steps.

REVIEW APPROACH AND PROCESS

The current review was based on search of peer-reviewed literature published between 1 April 2016 and 13 April 2017, conducted on 14 April 2017. PubMed, Global Health, Academic Search Premier, and Cochrane databases were searched using the terms: (eHealth OR telemedicine OR mobile phone* OR cell phone* OR SMS OR mhealth OR mobile health* OR m-health OR electronic health* OR eHealth OR e-health OR text message* OR mobile message* OR smart phone* OR smartphone* OR social media* OR mobile technology* OR computers, handheld) AND (training OR education OR teaching OR delivery of healthcare) AND (HIV OR HIV infections), producing 207 unique references. Of these, 65 full text articles were assessed by one author (C.S.T.), with 29 included in this review. Inclusion criteria were based on content including eHealth, telemedicine, or innovative provider training or support interventions for HIV care, including ICT or other technology descriptions relevant to provider-targeted interventions.

HUMAN RESOURCE INTERVENTIONS FOR HIV CARE & RELEVANCE OF ELECTRONIC HEALTH

In considering education and support for HIV care providers, we extended our review scope to include: traditional in-service training for health professionals without eHealth modalities; training of alternate HIV care providers, a broad cadre of health workers in less resourced settings who often complement or substitute for certified professionals; and non-eHealth approaches to extend reach of services (Table 1). Our rationale for including these publications is to lay a foundation for available and potentially successful care models to which eHealth technologies may be applied to streamline or further extend care. Ultimately, the performance of health providers will depend on quality improvement methods, coaching, mentoring, and supportive supervision that maximize impact. Vasan et al. [7**] summarized evidence for these methods on the performance of healthcare workers in primary healthcare settings in a systematic review. The authors found that many (57.5%) studies addressed ‘supportive supervision’ and found generally positive results, with seven of the 40 reviewed studies being randomized controlled trials (RCTs). Despite this volume and rigor, they noted little clarity about the most effective features of supervision, as well as the design, implementation, and monitoring of supervision programs. The same was true for the other dimensions of interventions for improved healthcare worker performance, for example, mentoring, coaching, and quality improvement. Next steps should include reaching a consensus on a systematic definition of supportive supervision and mentoring, to be followed by establishing standards specific to HIV care for each of these activities.

Specific interventions focusing on training for health professionals found positive impact on HIV patient care for stigma and rights-based care and influenza guideline training.[4,5] and, within a review assessing approaches to improve prevention of mother to child transmission, on maternal antiretroviral treatment (ART) use [10].

Alternate HIV care providers, cadres typically serving as community outreach workers, peer navigators, or frontline primary healthcare providers, may be able to reach clients who would otherwise be left without HIV care and treatment and, most importantly, make services more cost-efficient and client-friendly. As part of building evidence on task shifting to lower-level and lay providers and associated positive benefits, Ma et al.’s [11*] systematic qualitative review found that task shifting reduces the shortage of medical professionals in lower and middle-income countries, improves the psychosocial well being of PLHIV, and strengthens the relationships between PLHIV and health providers by building trust. With implications for the training and capacity building of providers, the authors present evidence that essential knowledge and problem-solving skills were more useful than diseasespecific treatment literacy in training for lay health
### Table 1. Description of peer-reviewed articles containing alternate provider training approaches for HIV and related care published between April, 2016 and April, 2017 (n = 8)

<table>
<thead>
<tr>
<th>Provider-targeted interventions</th>
<th>Lead author</th>
<th>Study site</th>
<th>Intervention</th>
<th>Study design/ analytic approach</th>
<th>Primary aim</th>
<th>Primary outcome</th>
<th>Main findings</th>
<th>Limitations</th>
<th>Rationale for inclusion in review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duque et al. [4]</td>
<td>South Africa</td>
<td>Influenza guidelines training for public sector providers</td>
<td>Crossover survey of HCWs</td>
<td>To describe knowledge, attitudes, &amp; practices regarding influenza and the vaccine among South African HCW</td>
<td>Influenza vaccination by HCWs</td>
<td>Only 19% of providers received influenza training while &gt;80% were aware national vaccination guidelines or campaigns</td>
<td>Findings are limited to HCP in the public sector; response rate for study unknown; representativeness of study participants to South African HCW community at large unknown</td>
<td>Influenza vaccination practices critical in high HIV prevalence settings</td>
<td></td>
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<tr>
<td>Geibel et al. [5]</td>
<td>Bangladesh</td>
<td>2 day HIV &amp; sexual &amp; reproductive health rights based training with stigma reduction component followed by 1 day refresher stigma reduction training 6 months later</td>
<td>Prequestionnaire and postquestionnaire following training</td>
<td>To evaluate effects of a HIV stigma reduction training program</td>
<td>Changes in personal values and negative impacts of stigma</td>
<td>Following stigma training, provider agreement that HIV should be a frame of themselves decreased substantially as did agreement that sexually active young people and MSM engage in ‘immoral behavior’ Young clients reported improvement in overall satisfaction with services after stigma trainings</td>
<td>Lack of comparison group in provider cohort study design Study conducted among narrowly defined group Client exit interviews did not have a true baseline measurement taken before first integration training</td>
<td>Stigma and discrimination reduction critical in healthcare settings, particularly those serving key populations</td>
<td></td>
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<tr>
<td>Sangiya et al. [6]</td>
<td>Tanzania</td>
<td>Nutrition counseling &amp; care directed for pediatric HIV patients for frontline providers</td>
<td>Cluster-randomized controlled trial</td>
<td>To examine the efficacy of nutrition training intervention to improve MLP nutrition knowledge &amp; feeding practices &amp; nutrition status of HIV-positive children</td>
<td>Mean nutrition knowledge scores of MLPs, weight gain among children</td>
<td>Mean nutrition knowledge scores were higher posttraining; Mean incremental weight gain observed at follow-up compared with baseline among children of the intervention arm</td>
<td>Results dependent on self-report &amp; recall of caregivers in measuring feeding practices; 6-month follow-up may be too short to observe significant change in long-term outcome variables (e.g. stunting)</td>
<td>Measuring nutrition in nutrition of HIV positive children under-evaluated</td>
<td></td>
</tr>
<tr>
<td>Vasan et al. [7]</td>
<td>Multiple countries</td>
<td>N/A</td>
<td>Systematic review of 40 studies</td>
<td>To summarize studies evaluating effectiveness of various approaches in improving performance among HCW</td>
<td>Various measures of HCW performance</td>
<td>Most extensive literature was an; super; sion; but little clarity on what defines most effective approach to the supervision activities Limited literature on mentoring, largely focused on clinical skills building &amp; educational strategies No HIV/AIDS eHealth interventions met eligibility criteria because did not target provider performance improvement as outcome, or were not targeted at primary care delivery</td>
<td>Search terms were restrictive with respect to countries studied &amp; particular level of the health system targeted</td>
<td>Unite is known about the effectiveness of performance improvements interventions for HCWs in low income and middle-income settings</td>
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</tbody>
</table>
| Client-targeted interventions | Bassett et al. [8] | Durban, South Africa | Trained healthcare navigators to link newly-diagnosed TB patients | Randomized controlled trial | To evaluate the efficacy of health system navigators for improving linkage to HIV and TB care among newly diagnosed HIV infected patients | Completion of ≥3 months of ART or ≥6 months of TB treatment for co-infected participants | ~40% of ART eligible participants in both study arms reached primary outcome 9 months after HIV diagnosis | Trial assessed role of health system navigators, a cadre increasingly used in health systems but under-evaluated |}

*HCW* = health care worker, *HCWS* = all health care workers, *ART* = antiretroviral therapy, *MSM* = men who have sex with men, *MSM* = men who have sex with men, *TB* = tuberculosis

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**Notes:**

- **Table 1.** Description of peer-reviewed articles containing alternate provider training approaches for HIV and related care published between April, 2016 and April, 2017 (n = 8).
- **Lead author**
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- **Intervention**
- **Study design/ analytic approach**
- **Primary aim**
- **Primary outcome**
- **Main findings**
- **Limitations**
- **Rationale for inclusion in review**

**Provider-targeted interventions**

- Duque et al. [4] South Africa
- Geibel et al. [5] Bangladesh
- Sangiya et al. [6] Tanzania
- Vasan et al. [7] Multiple countries

**Client-targeted interventions**

- Bassett et al. [8] Durban, South Africa
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<tr>
<td>Kojima et al. [9]</td>
<td>Mysore, India</td>
<td>Two-stage intervention: training of traditional birth attendants &amp; other frontline providers, followed by mobile clinics with specially-trained community health workers &amp; healthcare providers for reproductive &amp; child healthcare</td>
<td>Program evaluations</td>
<td>To determine impact of service provider training followed mobile clinic system to educate rural communities about maternal/child health &amp; provide comprehensive antenatal care, &amp; PMTCT of HIV in large rural catchment area of pregnant women</td>
<td>Uptake of educational sessions, HIV testing, STI testing, &amp; treatment</td>
<td>Educational sessions were delivered to &gt; 15,000 men &amp; women. Integrated antenatal care &amp; HIV/sexually transmitted infection testing was offered to 3545 pregnant women.</td>
<td>Program results are from one setting only and not generalizable to other communities. Cost-effectiveness not analyzed. Mobile clinics can reach population segments who are underserved.</td>
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Review with mixed approaches

| Ambia & Mandala [10] | Multicountry | N/A | Systematic review of 34 studies | To evaluate the effectiveness of interventions that aim to improve PMTCT service delivery and promote retention throughout the PMTCT steps | Various | Specific provider-based interventions focused on CHWs, service integration/enhanced referrals, & midwife training. Midwife training intervention increased maternal ART initiation. Interventions combining structural & provider-training components had mixed results. Mobile-phone-based reminders may increase the uptake of early infant diagnosis of HIV. Studies on male partner involvement in PMTCT reported reductions in infant HIV transmission. | Heterogeneity of interventions limited analyses | Review included use of CHWs, midwives |

Ma et al. [11] | Multicountry | N/A | Systematic review of 31 qualitative research studies | To summarize qualitative research on experiences, attitudes, and acceptability of interventions to improve ART adherence among PLHIV and treatment providers | Measurable improvements in ART adherence among PLHIV and treatment providers | Empowerment of PLHIV is a major benefit identified in several types of adherence interventions, including task shifting, education & mobile phone text message interventions. HIV care task shifting to lay workers found to be highly acceptable to clients & providers in low & middle income countries. | Studies included used data from single interviews without follow-up observations. Results would have benefitted from paired qualitative-quantitative studies. | Qualitative research on ART adherence interventions can provide a deeper understanding of intervention facilitators and barriers. |

ART, antiretroviral treatment; HCW, health care provider; HCW, healthcare workers; MLPs, midlevel providers; PLHIV, people living with HIV; PMTCT, prevention of mother-to-child transmission; STI, sexually transmitted infection; TB, tuberculosis.
workers. However, the best strategy has not yet been identified to effectively build capacity in and sustain the quality of these alternate providers. A targeted nutrition training intervention for frontline providers was found to have some improved weight gain among pediatric HIV patients with wasting compared with control clinics in a cluster-randomized trial but follow-up was too brief to determine impact on stunting [6].

Last, interventions using novel approaches to HIV care provision with human resources were included. A program report with a two-phase intervention of training traditional birth attendants and other community-based cadres for counseling and providing mobile care units with both health professionals and frontline providers in India reported considerable patient reach but had no comparator group [9]. Bassett et al.’s [8] RCT is, as stated by the authors, the first published study to evaluate the effectiveness of patient care ‘navigators’ to optimize treatment for HIV and tuberculosis (TB). Even with this study’s robust methodology and outcome measures to evaluate the efficacy of the navigator intervention for combined HIV and TB treatment, the authors found no difference in treatment outcomes between the intervention and standard care group. Although the authors note that intervention intensity — in this case, the performance of the navigators — was perhaps insufficient to improve outcomes, the study demonstrates the value of a rigorous evaluation design to indicate an intervention’s effectiveness, weaknesses, and potential modifications for improvement.

ELECTRONIC HEALTH INTERVENTIONS
eHealth can encompass a variety of technological approaches, and 13 articles were included within this group (Table 2). Articles in this section were diverse, ranging from design or results of trials studying provider-centered interventions, project development and pilot studies, reviews of eHealth interventions partially or exclusively focusing on HIV, and evaluations of enhanced EMR or human resources information systems (HRIS) that included components to facilitate delivery of HIV care by providers. A single cluster-randomized intervention trial assessed the efficacy of an EMR enhanced with an embedded clinical decision support system on HIV treatment failure outcomes [16**]. In that study, intervention facility providers received alerts via EMR for two types of notifications: when patients had a critical CD4 value or missed lab and to suggest clinical actions in response to lab results and recorded medications. Control facility providers only received a standard monthly patient report. Patients with immunologic treatment failure at intervention facilities were three times more likely to have treatment changed and had significantly shorter times from alert to action and from ART initiation to first laboratory monitoring. The evidence was high quality with analyses adjusted for potential confounding of differences in baseline disease stage at entry, and the results suggest that EMR systems to prompt provider action should be considered for scale-up. These systems are increasingly present in public-sector facilities and their functionality becomes more robust over time. However, the inability to eliminate article-based records as the initiating step and need for data clerks with the associated staffing and training burden should be improved in future iterations of EMR-based interventions. Three articles also provide insight into potential for merging provider-targeted interventions with EMR. Kang’a et al. [14*] reviewed EMR platforms in Kenya against national standards in 2012 and found that few of the evaluated EMR systems incorporated any integrated clinical decision-making aids. Two other program reports describe EMR and HRIS systems that incorporate provider-targeted components to improve care [18,19*]; these systems work to integrate different databases to ensure comprehensive data are available to providers. Rettler et al. [18] describe software that merges clinical site EMRs with the public health department’s system to ensure HIV patients are retained within the cascade through notifications to field epidemiology personnel. Waters et al. [19*] report on an innovative system in Mozambique that merges data on provider skill sets, determined by in-service training and certification, and clinical sites needing personnel with those skills in areas the providers prefer, increasing likelihood of provider retention. However, efficacy data using patient outcomes and provider knowledge and satisfaction measures are needed before these demonstration models can be recommended at larger scale.

Mobile-platform-based interventions are described in several articles and address a variety of HIV care areas, but efficacy data are lacking or data suggest no intervention impact [13,23]. A Kenyan review called for greater evaluation of mobile-based interventions generally; two recent systematic reviews found few HIV eHealth interventions targeting providers overall [22*,23], and it is hoped that planned interventions will incorporate rigorous evaluation into design [12]. Internet-based interventions comprise models that act as provider proxies in a high-resource setting [20,21] or more directly supply information to health providers [15*,17*]. These interventions all assume a certain knowledge of and access
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<tbody>
<tr>
<td>Claborn et al. [12]</td>
<td>Two northeastern sites, United States</td>
<td>CCI provider educational program for patients with HIV &amp; substance use disorders comprising mobile application for treatment providers, interagency communication protocol, &amp; training protocol</td>
<td>Three-phase formative intervention design and feasibility testing (protocol)</td>
<td>To develop and test CCI for provider education to better coordinate HIV &amp; substance abuse care</td>
<td>Establish feasibility and acceptability of a CCI &amp; assessment procedures</td>
<td>N/A</td>
<td>Trial in progress</td>
<td>Insight into future modalities, as intervention planned to include mobile application tool for providers targeting care coordination</td>
</tr>
<tr>
<td>Gupta et al. [13]</td>
<td>Maharashtra (excluding Mumbai), India</td>
<td>Mobile-phone-based tracking &amp; reminder system for providers to trace pregnant mothers living with HIV &amp; HIV-exposed infants</td>
<td>Program design and pilot implementation report</td>
<td>Assess utility of web-based mobile monitoring tool, for tracking of HIV-exposed children for EID to 18 months.</td>
<td>Successful development &amp; pilot test of mobile/EMail reminder system to providers for EID</td>
<td>System designed for facility-entered records of HIV- mothers &amp; delivery dates to be sent to central facility and imported into unidirectional mobile system sending emails and reminders to providers for mobile messaging. From 578 facilities, reported increase in infant testing from 55.9% (637/1139) to 68.4% (1117/1631) of 6 weeks for DNA-PCR in the 12 months preceding and follow-up pilot. 18 months confirmatory HIV testing increased from 45.6% (934/2044) to 54.7% (1118/2044).</td>
<td>System appears helpful but authors suggest can be further improved by greater electronic contact with increasing smartphone use. Agree with concern from authors regarding cost of mobile messaging &amp; also note concerns surrounding confidentiality based on unique identifiers transferred from facility to central government office. Lack of provider training description and input from providers &amp; patients. RE actual utility limits potential application</td>
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<tr>
<td>Kang’a et al. [14 &amp; 15]</td>
<td>Kenya</td>
<td>N/A</td>
<td>Cross-sectional program assessment</td>
<td>Evaluate how EMR platforms in Kenya in 2012 performed against national EMR standards</td>
<td>Measurement of specific EMR performance area as seven review domains</td>
<td>EMRs scored highly (in descending order) in health information &amp; reporting, security, system features, core clinical information, &amp; order entry criteria; scored lowest against clinical decision support &amp; interoperability criteria. Key weakness identified as reduced ability to guide clinical decision-making (e.g., patient referral; managing drug interactions; exchanging clinical information &amp; patient summaries; electronically prescriptions, laboratory orders, and results. Four EMRs met 60.0% threshold: OpenMRS, IQCare, C-PAD &amp; Funsoft</td>
<td>No description of direct provider education or service extension outcomes reported. Evaluation team included HIV care providers but did not elicit facility provider input on system utility.</td>
<td>Although the authors do not describe direct provider education or service extension outcomes or processes within the EMR, the potential for EMR systems to enable this process should be considered as system refinement and scale-up occurs to ensure inclusion within the main system rather than need for parallel programming</td>
</tr>
<tr>
<td>Kuehne &amp; Keijler [15*]</td>
<td>Cape Town, South Africa</td>
<td>Self-produced video clips of scripted provider-patient interactions for HIV-TB care watched via YouTube to augment clinical teaching in busy clinic</td>
<td>Learning intervention pilot test</td>
<td>Evaluate using self-produced video-clips to supplement face-to-face clinical teaching in a busy clinic</td>
<td>Student satisfaction and knowledge gain</td>
<td>Students found watching video clips on YouTube and then attending clinic visits and discussing a case afterward acceptable and useful learning adjunct, but desired question and feedback session</td>
<td>Number of students tested &amp; specific content &amp; validation process of script not described</td>
<td>Model may present useful modality for in-service training, particularly if linked with providers for discussion following video view. Relies on sufficient Internet connectivity and provider possession of tablet or smartphone</td>
</tr>
</tbody>
</table>
Provider reminder/clinical guidance system housed within EMR represents a novel approach and rigorous evidence supports associated improved patient HIV care outcomes. Reliance on written test and limited number of data entry clerks at facilities necessitates ongoing training cycles. EMR system enhancement can include provider prompts and suggested clinical actions to optimize retention in HIV care cascade; models developed here and elsewhere would benefit from efficacy trials as technology becomes more robust.

Of ART patients, 1125 (11%) in control and 1342 (12%) in intervention groups had immunological treatment failure, of whom 332 (30%) and 737 (55%), respectively, had appropriate action taken (AOR 3.18, 95% CI 1.02–9.87). Median time from alert to action was 13 (95% CI 11–14) vs. 47 days (28–86; P < 0.001) and to ART initiation from first CD4 count was 6.8 vs. 12.1 months in intervention vs. control groups, respectively. In 1149 (97%) of cases, clinicians reported appropriate action had been taken, but not recorded in charts. No feedback obtained from clinicians regarding whether alerts prompted action or user friendliness of MAVEN.

In 1445 cases, clinicians did not act on recommendations following an alert. In 1109 (77%) of cases, clinicians reported appropriate action had been taken, but not recorded in charts. No patient outcome data.

Table 2 (Continued)

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<tr>
<td>Oluoch et al. [18]</td>
<td>Siaya Province, Kenya</td>
<td>CDSS sending alerts &amp; clinical guidance to providers integrated within EMR</td>
<td>Prospective cluster randomized trial</td>
<td>Evaluate impact of CDSS within EMR vs. standard EMR info on ART failure identification &amp; ART regimen change based on provider interaction</td>
<td>Difference between groups in proportion of patients experiencing ART treatment failure &amp; had a documented clinical action</td>
<td>Of ART patients, 1125 (11%) in control &amp; 1342 (12%) in intervention groups had immunological treatment failure, of whom 332 (30%) and 737 (55%), respectively, had appropriate action taken (AOR 3.18, 95% CI 1.02–9.87). Median time from alert to action was 13 (95% CI 11–14) vs. 47 days (28–86; P &lt; 0.001) and to ART initiation from first CD4 count was 6.8 vs. 12.1 months in intervention vs. control groups, respectively.</td>
<td>No feedback obtained from clinicians regarding whether alerts prompted action or user friendliness of MAVEN.</td>
<td>Provide reminder/clinical guidance system housed within EMR represents novel approach &amp; rigorous evidence supports associated improved patient HIV care outcomes.</td>
</tr>
<tr>
<td>Park et al. [19]</td>
<td>Botswana</td>
<td>Impact of Internet access to Wikipedia at no cost on health information use &amp; access by providers</td>
<td>Qualitative program assessment</td>
<td>Identify clinical information needs of &amp; perceptions of Wikipedia as a clinical tool among HCWs</td>
<td>Themes surrounding current information sources, perceived utility, &amp; clinical information needs</td>
<td>Current information compromised by limited Internet access at facilities due to infrastructure and other issues &amp; limited confidence in other information resources (e.g., books, MoH publications) as many outdated.</td>
<td>Lower-level health posts were underrepresented in sampling. Variations in IT literacy among provider participants.</td>
<td>Efforts to improve health information access with popular sites are well intended but require provider buy-in on whether source is reliable &amp; training in how best to use electronic information resources.</td>
</tr>
<tr>
<td>Ratliff et al. [18]</td>
<td>Massachusetts, United States</td>
<td>Integrated clinical alert system with EMR for HIV providers</td>
<td>Retrospective program report</td>
<td>Assess feasibility and function of consolidated MAVEN electronic system enhanced to document &amp; triage clinic-level, laboratory-level, &amp; patient-level surveillance, field epidemiology, &amp; capture HIV care continuum data with provider alert feature</td>
<td>System implementation &amp; function</td>
<td>System-based challenges included decreased recognition of HIV follow-up visits due to care standard or ICD-9/10 coding changes, incompatibility between different EMR systems. Clinicians require training on accurate EMR information entry &amp; coding accuracy to ensure maximum capture &amp; recognition of cases falling out of care to then sending a subsequent alert to clinic of origin.</td>
<td>No feedback obtained from clinicians regarding whether alerts prompted action or user friendliness of MAVEN.</td>
<td>No patient outcome data. (Retention in HIV care cascade) or perceptions regarding whether quality of care improved.</td>
</tr>
<tr>
<td>Waters et al. [19]</td>
<td>Mozambique</td>
<td>Tracking of provider in-service training &amp; provider skills vs. facility needs within national health service</td>
<td>Retrospective program report</td>
<td>Document novel national HRIS approach &amp; key success factors</td>
<td>System development, implementation, &amp; key strategic data use</td>
<td>System used to identify variety of HIV-related human resource issues, translatable to other fields of care. Availability of providers based on presence of enrollment &amp; recent in-service training for HIV service capacity. Tracking of in-service training &amp; supportive supervision received; ART/PMTCT trained nurses not consistently assigned to facilities providing those services.</td>
<td>No provider feedback or long-term data on whether targeted clinic assignment improved staff retention; No data regarding utilization of system to increase in-service training coverage.</td>
<td>Scaleup of similarly robust HRIS systems will be useful adjacent to determining training needs &amp; pairing with appropriate eHealth interventions for HIV care.</td>
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Table 2 (Continued)

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<td>Bith et al. [20]</td>
<td>London, United</td>
<td>Social media used to augment National HIV Testing Week</td>
<td>Retrospective program description</td>
<td>To describe impact of social and other media to increase outpatient HCT during National HIV Testing Week</td>
<td>Number patients accepting testing; number reached by Twitter</td>
<td>2402 target 2500 OPD/A&amp;E patients accepted testing; 8 case (3 new) detected 238860 hits received on Twitter</td>
<td>Lack of provider evaluation of training quality or knowledge; Did not measure HCT refusal rate</td>
<td>Training emphasizes need for providers to learn &amp; consider utilizing electronic/social media for patient outreach</td>
</tr>
<tr>
<td>Gibbs et al. [21]</td>
<td>England</td>
<td>Online system to provide diagnosis &amp; initial care for patients in lieu of provider; provider-extender</td>
<td>Program design &amp; pilot implementation report</td>
<td>Develop online management system for home-based results/ treatment of sexually transmitted infection</td>
<td>Successful pilot of automated system providing results through medication dispensing</td>
<td>Online algorithm developed to maintain portal whereby patients access STI test result; complete clinical consultation to determine safety/appropriateness of remote prescription; Electronic prescribing; and recording of whether treatment received with follow-up call for partner tracking</td>
<td>Tested only for bacterial STIs to date; Application to home-based HIV testing only proposed by authors; Requires patient facility with access to Internet</td>
<td>Per authors input, system may be used for home-based HIV testing for immediate information/assistance with results interpretation, referral for ART/ counseling, to reduce stigma that may present barrier to testing at facility</td>
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Technology Assessments/Reviews

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Country(ies)</th>
<th>Study type</th>
<th>Description</th>
<th>Analysis approach</th>
<th>Primary aim</th>
<th>Primary outcome</th>
<th>Main findings</th>
<th>Limitations</th>
<th>Rationale for inclusion in review</th>
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</thead>
<tbody>
<tr>
<td>Njiru et al. [22]</td>
<td>Kenya</td>
<td>N/A</td>
<td>Systematic literature review of 69 project publications &amp; reports</td>
<td>Situational analysis of eHealth interventions implemented in Kenya</td>
<td>N/A</td>
<td>69% of projects involved eHealth with 25% of overall projects focused on HIV; most were concentrated in Nairobi &amp; more developed counties; Few (3/15) projects piloted with intent of having national reach were then implemented nationally; eHealth (11%; n = 8); telemedicine (7%; n = 5) comprised few of reviewed projects</td>
<td>Only 41% of projects reported evaluation following implementation; 8 trials with efficacy data</td>
<td>No evaluated SMS project involved messaging/education for HIV care providers; Interventions tended to target a specific area or population &amp; did not consider overall MoH health priorities; Review not notable for small number of provider training/education interventions (5%) &amp; lack of evaluation overall, particularly with sufficient rigor, for all eHealth interventions; There were few eHealth &amp; telemedicine interventions, reflecting potential need for provider-targeted intervention development &amp; efficacy assessment of existing models</td>
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<tr>
<td>Posadzki et al. [23]</td>
<td>Multiple countries</td>
<td>N/A</td>
<td>Cochrane systematic review of 132 trials</td>
<td>Assess effects of unidirectional, bidirectional, &amp; combination interventions using ATCS for preventing disease &amp; managing long-term conditions on various clinical outcomes</td>
<td>Multiple health outcomes as specified in trials/studies meeting inclusion criteria</td>
<td>Only 53/132 included studies dealt with HIV care; 2 assessed bidirectional interventions to monitor injecting drug use and alcohol use among HIV patients; 1 complex intervention assessed ART adherence; 0/3 HIV-related trials had significant durable impact on related primary outcomes of decreased alcohol consumption at 12 months, decreased injecting drug use, or improved ART adherence</td>
<td>Few HIV care-related studies, possibly due to data cut-off at 2015</td>
<td>Authors concluded there was insufficient evidence to recommend ATCS interventions for improvement of HIV care extension; for patients/provider contact; ATCS has potential as care extender by eliciting &amp; facilitating follow-up information through automated system; consider application of successful models to aspects of HIV care extension</td>
<td></td>
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<tr>
<td>Yah et al. [24]</td>
<td>Multiple countries</td>
<td>N/A</td>
<td>Scoping review</td>
<td>Describe telemonitoring/telehealth TB/HIV interventions potentially applicable to sub-Saharan Africa</td>
<td>N/A</td>
<td>General descriptions of traditional intervention models for HIV/TB community sensitization; prevention, early diagnosis, prevalence monitoring, &amp; tele-treatment for HIV/TB, &amp; immunization with potential eHealth &amp; telemedicine modalities</td>
<td>Immunization received relatively less emphasis Sparse content on provider education interventions Did not follow standard review guidelines (PRISMA)</td>
<td>Review article focusing more on behavioral determinants of health outcomes &amp; potential application of eHealth modalities to address them but limited matching with actual eHealth program models limits utility of this review</td>
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</table>
to electronic media and, while smartphone use is expanding, interventions of this type may not be feasible for providers in some settings. Social media or an Internet platform to extend sensitization or care activities are promising in a high-resource setting and would benefit from efficacy data specifically for HIV care, patient input on user friendliness and confidentiality, and care outcomes [20,21]. Confidence in quality and reliability of information was also relevant to program assessments for provider learning where Wikipedia (Wikipedia.org), an open database with no internal validation, was provided as a potential electronic resource for health information with mixed reviews. From that study, rural providers identified the need for accessible, curated content specific to national guidelines and information to be made available in urgent situations [17*]. An innovative approach to controlled content to supplement eHealth initiatives was also presented, linking program-generated video of scripted patient encounters through YouTube (LLC, San Bruno, California, US) [15*]. This model holds promise and should be considered for augmentation of in-service training and support; formative studies are in process to determine best host sites (e.g., YouTube, WhatsApp Inc, Mountain View, California, US, Skype; Communications SARL, Luxembourg) in areas with variable connectivity, and cost-effectiveness in settings where smartphone use and connectivity are expanding. Larger sample sizes and rigorous trial design will be required to measure efficacy.

TELEMEDICINE INTERVENTIONS

Telemedicine interventions (Table 3) were more homogeneous than those identified for eHealth. Primary programs/studies included evaluation of four provider-focused telemedicine interventions, [26**,27*,28*,29**] and two telephone-based care extension interventions in which providers called HIV patients with depression for consultation and symptom monitoring [25*,30]. We also included a review [32] and a technology and study protocol description [31**] that featured technology relevant to telemedicine intervention design and programming considerations.

The Extension for Community Healthcare Outcomes (ECHO) model offers rural providers access to a multidisciplinary care team at an academic center and to other rural providers to create a community of practice with weekly online sessions. This program was evaluated by two separate implementing groups, [26**,29**] with differing experiences between the two. The Washington group had providers joining from four other states; these providers rated the program highly and may have self-selected due to their and their patient populations’ greater isolation from HIV specialty referral sites as compared with the population in the second study [26**,29**]. The second study described ECHO super-imposed on the Veterans Administration system in the United States, in which referrals are possible but often require long-distance travel that is inconvenient for PLHIV in rural areas [26**]. Moeckli et al. [26**] considered this factor, noting that specialty providers were often reluctant to relinquish care and believed PLHIV preferred to stay with providers with whom they had already developed rapport, whereas primary care providers felt more comfortable referring care to established specialist teams. The publications eligible for review inclusion for the two US projects did not analyze key patient outcomes, such as viral suppression or annual viral load monitoring, so we cannot comment on program efficacy at the patient level.

In Malawi and Botswana [27*,28*], two studies describe systems analogous to ECHO that worked effectively in settings in which referrals are not possible or feasible. One potential weakness in a low-resource setting, however, is the reliability of Internet connection for meetings with a team of experts. In a tertiary facility in the national capital of Malawi, a pathology telemedicine intervention resulted in successful pathology team consultations, achieving high concordance in cytologic and histologic diagnosis. But Montgomery et al. did not comment on connectivity issues and their potential impact on consultative meetings [27*]. A study in Botswana used a smartphone-based consultation service for dental cases, which may be a better paradigm as providers used smartphones to send data and photos to experts in the capital, Gaborone. However, more data are needed on differences between expert management recommendations and course of care, particularly on biopsy access and follow-through [28*]. This smartphone model may be more practical due to popularity and widespread use of applications like WhatsApp that allow low-cost text/file transmission and calls through subscriber Internet coverage while avoiding mobile network charges. As Internet coverage and smartphone ownership increase in low resource settings, this approach may gain traction. In Botswana, another solution is being explored that may resolve connectivity issues by using underutilized television bandwidth. Chavez et al. [31**] describe plans to extend the current national telemedicine model to this ‘white space’ band and assess whether connectivity and expansion of expert clinical guidance across primary care fields make a measurable impact on provider access, knowledge, and quality of care. We recommend that the team also evaluate
One of few qualitative studies that explore human component of telemedicine and determine patient preferences to create sense of therapeutic alliance. Inclusion of only three facilities in interviews.

Nearly all providers & patients found off-site service helpful & desired to continue. Providers summed positive aspects as having a focused provider assessing depression/mental health issues & having call notes to guide discussion at next care visit.

Several providers commented they were too busy to ensure they adequately screened for or followed up depression symptoms or efficacy of the antidepressants prescribed at a prior visit, despite EMR alerts. Telephone service viewed as a necessary adjunct for complete care provision. Pharmacist on the remote team was also positively perceived for medication recommendations to reduce potential side effects. Patients found telephone calls acceptable & some preferred telephone-based care as felt Depression Care Manager truly cared about them.

Table 3. Description of peer-reviewed articles containing information on telemedicine for HIV and related care providers published between April, 2016 and April, 2017 (n = 8)

<table>
<thead>
<tr>
<th>Lead author</th>
<th>Study site(s)</th>
<th>Intervention</th>
<th>Study design/ analytic approach</th>
<th>Primary aim</th>
<th>Primary outcome</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Dismore et al. [25]</td>
<td>Three Southern states, United States</td>
<td>HITIDES project: collaborative care with enhanced usual care in HIV clinics. An offsite HIV depression care team (psychiatrist, a DCM, &amp; clinical pharmacist) provided collaborative care &amp; made recommendations to providers through EMR system. The DCM delivered care management through phone calls.</td>
<td>Multistage formative evaluation</td>
<td>Explore patient &amp; provider satisfaction &amp; challenges identified with HITIDES intervention</td>
<td>Nearly all providers &amp; patients found offsite care helpful &amp; desired to continue. Providers summarized positive aspects as having a focused provider assessing depression/mental health issues &amp; having call notes to guide discussion at next care visit. Several providers commented they were too busy to ensure they adequately screened for or followed up depression symptoms or efficacy of the antidepressants prescribed at a prior visit, despite EMR alerts. Telephone service viewed as a necessary adjunct for complete care provision. Pharmacist on the remote team was also positively perceived for medication recommendations to reduce potential side effects. Patients found telephone calls acceptable &amp; some preferred telephone-based care as felt Depression Care Manager truly cared about them.</td>
<td>Quantitative results not summarized, through interviews conducted in 2007–2009 with change in care norms since that time. Inclusion of only three facilities in interviews.</td>
<td>One of few qualitative studies that explore human component of telemedicine &amp; determine patient preferences to create sense of therapeutic alliance.</td>
<td></td>
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<tr>
<td>Mauch et al. [26]</td>
<td>West Coast (2) &amp; Midwest (1) Veterans Administration health centers, United States</td>
<td>ECHO is a provider level telemedicine model whereby urban multispecialty care team conducts regular video conferencing with rural/remote providers for in-service training &amp; telemedicine consultation.</td>
<td>Mixed methods evaluation</td>
<td>Measure level of contextual factors influencing uptake of HIV ECHO program</td>
<td>43% of clinics adopted ECHO over 3 years but additional coverage areas (infectious diseases) were added to increase appeal. Low (17%) patient uptake as remainder continued to receive care at HIV specialty clinics; no difference between urban &amp; rural patients. Program perceived positively by patients &amp; providers but primary care providers felt many patient issues warranted referral rather than attempted remote management.</td>
<td>Not conducting program in very rural/isolated setting with no HIV care providers; Any patients or providers declining ECHO participation not interviewed.</td>
<td>Study provides alternate perspective on ECHO program as implemented within US Veterans Administration with qualitative interviews from both provider groups to identify potential advantages &amp; disadvantages.</td>
<td></td>
</tr>
<tr>
<td>Montgomery et al. [27]</td>
<td>Lilongwe, Malawi</td>
<td>Video &amp; online based telemedicine program for pathology consultation</td>
<td>Program report</td>
<td>Describe concordance in diagnosing lymphoproliferative disorders from pathology samples between telemedicine &amp; US confirmatory groups</td>
<td>Concordance rate between real-time &amp; confirmatory diagnosis &amp; description of range of diagnosed conditions over first 2 years of program.</td>
<td>Many cases were Burkitt’s lymphoma, particularly in pediatric patients. Discordance rates that would change clinical management 9 &amp; 5% for cytology &amp; fixed tissue slides, respectively. 74% &amp; 76% complete concordance for cytology &amp; fixed-tissue samples between real-time (Malawian pathologists and telemedicine conference review) &amp; US additional testing/assessment.</td>
<td>Samples biased toward acute/aggressive cases as more likely referred to tertiary program site. Low sample size.</td>
<td>Relevant telemedicine model provides consultation for outlying providers remote from specialists &amp; requires only mobile network access &amp; smartphones.</td>
</tr>
<tr>
<td>Tesfaldet et al. [28]</td>
<td>Botswana</td>
<td>Smartphone use for photo &amp; clinical information exchange for telemedicine program</td>
<td>Program report</td>
<td>Assess dental specialty telemedicine system’s impact on patients’ diagnoses &amp; management plans</td>
<td>23% (6/26) HIV prevalence among patients. Disparities, sometimes large, in diagnosis &amp; (more frequently) management plan of dental officer &amp; specialists. Many were attributed to officer opting for specialist referral while specialist advised biopsy or biopsy &amp; medication to obviate referral. Overall need for specialist referral reduced by 52% with telemedicine system.</td>
<td>Small sample size. Lack of long-term follow-up of patients to ensure treatments appropriate &amp; referrals completed.</td>
<td>Relevant telemedicine model provides consultation for outlying providers remote from specialists &amp; requires only mobile network access &amp; smartphones.</td>
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### Table 3 (Continued)

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<tr>
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<th>Study site(s)</th>
<th>Intervention</th>
<th>Study design/ analytic approach</th>
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<th>Rationale for inclusion in review</th>
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<tbody>
<tr>
<td>Wood et al. [26‡]</td>
<td>Washington &amp; surrounding states, United States</td>
<td>ECHO is a provider level telemedicine model whereby urban multispecialty care team conducts regular video conferencing with rural/remote providers for in-service training &amp; telemedicine consultation</td>
<td>Program report</td>
<td>Describe clinical problems prompting remote consultation requests &amp; evaluate changes in remote providers' self-assessed HIV care confidence &amp; knowledge</td>
<td>Descriptive analysis of clinical problems; confidence in HIV care provision, ability, feel part of HIV care community (pre/post)</td>
<td>Between 2012–2015, provider response rate 50% (45/90) on annual program evaluation survey</td>
<td>Low provider response rate, no input from providers on potential acceptability or challenges to use</td>
<td>One of two studies presenting ECHO model that may be translatable from Washington State to other settings, and provides expert input for improved knowledge and confidence in providing HIV care; see Moeckli et al. [29‡] for alternate perspective</td>
</tr>
<tr>
<td>Reynolds et al. [30]</td>
<td>Belgaum, Karnataka &amp; Bengaluru, India</td>
<td>Mobile Phone-Based Approach for Health Improvement, Literacy &amp; Adherence (MAHILA) trial delivered by nurses for enhancing self-care &amp; treatment adherence among HIV-infected women with depression symptoms</td>
<td>Randomized controlled pilot study (protocol)</td>
<td>Assess feasibility, acceptability, &amp; preliminary efficacy of intervention</td>
<td>Planned outcomes include antiretroviral treatment adherence (questionnaire &amp; viral loads), depressive symptoms (CES-D scores), illness perceptions, internalized stigma &amp; quality of life</td>
<td>Mobile phone intervention delivered by nurses for up to 16 weeks. Calls are made by the nurse at baseline &amp; 2-4x weekly during weeks 1–4, weekly during weeks 5–10, &amp; then at weeks 14 and 16. Script used to guide delivery of critical elements of intervention. Borrow duration &amp; content individualized to participant. Key components include: providing patient with individualized contextually congruent program; integrating screening for depression &amp; other concomitant risk factors; enabling proactive problem solving to aid in overcoming factors that may impede treatment engagement; improving early recognition of barriers and referrals; &amp; providing mediator (study nurse) between health system &amp; participants. Clinical follow-up at baseline, 4, 12, 24 &amp; 36 weeks post-randomization by blinded providers</td>
<td>Study to be implemented</td>
<td>Teleremedicine model to address HIV &amp; depression comorbidities while extending provider reach &amp; informing providers of patient status between visits</td>
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### Mixed interventions or technology descriptions

| Chavez et al. [31‡] | Botswana | Planned use of unlicensed television bandwidth (‘white space’) to expand national Kgonafalo telemedicine program and content to include TB, HIV, & general adult & pediatric care (family medicine) | Conceptual program description | Evaluate use of ‘white space’ for telemedicine program expansion | Design & implementation of pilot telemedicine program in ‘white space’ bandwidth to increase provider access | Advantages of ‘white space’ include low cost, signal strength in rural/isolated areas, & no crowding by commercial entities | No input from providers on potential acceptability or challenges to use | Television bandwidth has not been previously described for telemmedicine use and holds great potential in settings where Internet connectivity is unreliable |

**Table 3 Continued**

| Iribarren et al. [32‡] | N/A | Scoping review | Systematically compare text messaging platforms & summarize advantages & disadvantages | Functional features of platforms used for text messaging interventions with two-way communication capacity | Of 27 identified platforms, 6 were assessed/used for interventions tested in 21 studies. 9 platforms specifically targeted healthcare providers as end users (e.g., Celltrust, Sense Health). Platform challenges included maintaining patient confidentiality at HIPAA standard levels; data loss when power/network coverage not available; need for consistent telephone maintenance/ replacement & power for charging, limited message/alert sending capacity, & inability to integrate seamlessly with open access systems (e.g., DHIS-2, iHRIS) | Variation in features between platforms made critique difficult due to lack of comparability. Similarly, only a few platforms used in most studies & study outcomes rarely included platform functionality | Article provides important technical inputs when selecting & modifying a platform to enhance eHealth/telemmedicine programming |

**Note:**
- DCM, depression care manager; DHIS, district health information system; ECHO, extension for community health outcomes; EMR, electronic medical record; HITIDES, HIV translating initiatives for depression into effective solutions; HRIS, human resources information systems.

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**References:**
- [26‡] Moeckli et al.
- [29‡] Todd et al.
- [31‡] Reynolds et al.
- [32‡] Iribarren et al.
CONCLUSION

The current review of recent publications on HIV service provider training and performance enhancement evaluates mobile technology, telemedicine, and other innovative provider-targeted interventions utilizing eHealth for HIV-related care. Review articles and service assessments illustrated functionality of mobile phone and EMR platforms and highlighted best features to make the technology more robust for provider-targeted applications. Similarly, reviews on interventions to improve provider performance, both specific to HIV and for primary care generally, identified successes as well as the need for greater standardization of models for provider support, particularly following in-service training with supportive supervision and mentoring. New applications of technology show potential, including using YouTube to broadcast scripted educational videos, sending clinical case information through smartphones and mobile apps, and using ‘white space’ frequencies to improve connectivity and access to content. Despite the promise of these interventions, firm evidence is needed to determine how feasible eHealth programming is in low resource and rural settings where connectivity remains limited, serving as a key limitation among many of the articles reviewed. Approaches to maintaining patient confidentiality, particularly in telemedicine and EMR-based systems, were explicitly considered by some but not all of the interventions described in this review. Going forward, patient confidentiality protections within the program are a necessary component that should be given the same weight as ethical review board approval for formal evaluations and standard minimum protection guidelines developed for nascent eHealth projects. Evaluations of feasibility and efficacy must be done rigorously to optimize the power of technology for telemedicine and preservice/in-service training and to ensure success at scale-up. Given the rapid pace of technologic development and expansion of both Internet coverage and HIV prevention and treatment modalities, we anticipate substantive change over the next few years in provider training and service extension to meet the needs of clients living with HIV.

Acknowledgements

We would like to thank Carol Manion, Allison Burns, and Tamara Fasnacht for their assistance with the literature searches.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest


This comprehensive review article focuses on approaches and outcomes for provider posttraining support and performance improvement for various healthcare areas, which is critically important as many projects include this approach but there is little guiding evidence on best practices. The article’s conclusions are critical for further research in the field based on lack of standard definitions and approaches to mentoring and supportive supervision and paucity of provider performance improvement intervention evaluation to provide guiding evidence.


9. MIDR0102. The first randomized controlled trial assessing impact of health system navigators on HIV and tuberculosis outcomes in South Africa. Though findings showed no measurable impact on primary outcomes, study provides high-quality evidence on a care extending cadre with little prior evaluation data.


Electronic health, teledermicine, and new paradigms Todd et al.


This review article critically assesses different electronic medical record platforms used in Kenya and provides insight into key technological features. The article highlights considerations to guide further platform development and is relevant to all countries adopting medical records systems.


This brief project report describes using smartphone-produced video posted to YouTube to augment preservice training. The article is important because it highlights tools (e.g., Internet) increasingly available to all levels of health provider and creative approaches to increasing scripted content access to bolster in-service and preservice training efforts.


This is one of few randomized trial results included in the review, assessing the impact of a provider-targeted alert and decision support system within an electronic medical record (EMR) system on actual patient outcomes. This article is important because it provides high-quality evidence for provider electronic health (eHealth) interventions merged within EMR to guide scale-up efforts.


This article is among the first to describe use of widely available electronic reference sites by medical professionals for clinical advice. This article is included because it emphasizes provider recognition of need for open-source site with reference sites by medical professionals for clinical advice. This article is included because it describes provider-targeted information and resources that can be used to track in-service training and better match trained providers to clinical sites. As human resources databases become more robust and incorporated with EMR, the potential for in-service training and support within larger electronic systems is present, as exemplified in this article.


This article is important because it describes provider-targeted information and resources that can be used to track in-service training and better match trained providers to clinical sites. As human resources databases become more robust and incorporated with EMR, the potential for in-service training and support within larger electronic systems is present, as exemplified in this article.


This is one of few randomized trial results included in the review, assessing the impact of a provider-targeted alert and decision support system within an electronic medical record (EMR) system on actual patient outcomes. This article is important because it provides high-quality evidence for provider electronic health (eHealth) interventions merged within EMR to guide scale-up efforts.


This review summarizes all eHealth and mobile health (mHealth) interventions in Kenya and is important for three key observations. There is a paucity of eHealth programming targeting providers, there are few eHealth programs in underserved counties/rural regions, and there are few data evaluating program/approach efficacy.


This review article assesses technical aspects of various eHealth programming platforms and is important for guiding platform choice and features when designing mHealth/teledermicine programming.


This article provides qualitative results and insights to telephone-based care for HIV patients with depression and is important for guiding aspects of teledermicine programming needed to form a therapeutic alliance with patients.


One of two important articles presenting data from an HIV teledermicine program targeting rural providers and patients in the United States. This study details qualitative inputs from providers and patients within a system with an existing referral network to HIV specialists on why the teledermicine program was underutilized over time.


This article describes a pathology teledermicine approach utilizing video conferencing and imaging with fairly high diagnostic accuracy for lymphatic neoplasms between Malawian and US-based teams. The importance of this article is demonstration of how biopsy-based diagnosis can be made more available and reliable in limited resource settings, though with substantial initial investment.


This article describes a teledermicine program utilizing resources available to rural providers, predominantly smartphones. This study is important as it describes a viable approach for many settings and areas where diagnostic and management discordance between consultant and local provider can arise and how to manage the issues.


The second of two articles describing a teledermicine approach for rural HIV providers and patients, in this instance in settings without established referral networks. This study provides quantitative and qualitative inputs from rural provider participants over time and can guide design and implementation for similar scenarios.


This article describes a new, planned application of available and underutilized telecommunications bandwidth to an existing teledermicine program in Botswana. Although the article is limited to program design, it represents a detailed description of a potentially feasible and sustainable approach to teledermicine programming in resource-limited settings.


This review article assesses technical aspects of various eHealth programming platforms and is important for guiding platform choice and features when designing mHealth/teledermicine programming.