REVIEW

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Electronic health, telemedicine, and new paradigms for training and care

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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

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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 messag* OR mobile messag* OR smart phone* OR smartphone* OR social media* OR mobile technolog* 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 disease-specific 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 ($n = 8$)

Lead author	Study site	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	Influenza guidelines training for public sector providers	Cross-sectional survey of HCWs	To describe knowledge, attitudes, & practices regarding influenza and the vaccine among South African HCW	Influenza vaccination by HCWs	Only 19% of providers received influenza training while >60% were aware national vaccination guidelines or campaigns Reduced vaccine availability at health facilities were barrier to vaccinating patients 79% recommended flu vaccine all or most of time to HIV+ patients Having received a vaccine themselves and stating vaccine available at their facility independently associated with recommending flu vaccine to HIV+ clients, except for providers receiving govt. training	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	Influenza vaccination practices critical in high HIV prevalence settings
Geibel *et al.* [5]	Bangladesh	2 day HIV & sexual & reproductive health rights-based training with stigma reduction component; followed by 1 day refresher stigma reduction training 6 months later	Presurvey and postsurvey following training	To evaluate effects of a HIV stigma reduction training program	Changes in personal values and negative impacts of stigma	Following stigma training, provider agreement that PLHIV should be ashamed 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	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	Stigma and discrimination reduction critical in healthcare settings, particularly those serving key populations
Sunguya *et al.* [6]	Tanzania	Nutrition counseling & care directed for pediatric HIV patients for frontline providers	Cluster-randomized controlled trial	To examine efficacy of nutrition training intervention to improve MLPs nutrition knowledge & feeding practices & nutrition status of HIV-positive children	Mean nutrition knowledge scores of MLPs; weight gain among children	Mean nutrition knowledge scores were higher posttraining; Mean increment weight gain observed at follow-up compared with baseline among children of the intervention arm	Results dependent on self-report & recall of caregivers in measuring feeding practices; 6-month follow-up may be too short to observe significant changes in long-term outcome variables (e.g., stunting)	Role of MLPs in nutrition of HIV-positive children under-evaluated
Vasan *et al.* [7▪▪]	Multiple countries	N/A	Systematic comparative review of 40 studies	To summarize studies evaluating effectiveness of various approaches in improving performance among HCW	Various measures of HCW performance	Most extensive literature was on supervision, but little clarity on what defines most effective approach to the supervision activities Limited literature on mentoring, largely focused on clinical skills building & 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	Search terms were restrictive with respect to countries studied & particular level of the health system targeted	Little is known about the effectiveness of performance improvements interventions for HCWs in low-income and middle-income settings
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 outpatients	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	Intervention intensity was perhaps insufficient to improve outcomes, or tangible means to overcome identified care barriers (e.g., travel vouchers) may be needed	Trial assessed role of health system navigators, a cadre increasingly used in health systems but under-evaluated

Table 1 (*Continued*)

Lead author	Study site	Intervention	Study design/ analytic approach	Primary aim	Primary outcome	Main findings	Limitations	Rationale for inclusion in review
Kojima *et al.* [9]	Mysore, India	Two-stage intervention: training of traditional birth attendants & other frontline providers, followed by mobile clinics with specially-trained community health workers & healthcare providers for reproductive & child healthcare	Program evaluations	To determine impact of service provider training followed mobile clinic system to educate rural communities about maternal/child health & provide comprehensive antenatal care, & PMTCT of HIV in large rural catchment area of pregnant women	Uptake of educational sessions, HIV testing, STI testing, & treatment	Educational sessions were delivered to >15 000 men & women Integrated antenatal care & HIV/sexually transmitted infection testing was offered to 3545 pregnant women	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
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 benefited from paired qualitative-quantitative studies	Qualitative research on ART adherence interventions can provide a deeper understanding of intervention facilitators and barriers

ART, antiretroviral treatment; HCP, 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 as 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

Table 2. Description of peer-reviewed articles containing information on electronic health interventions for HIV and related care providers published between April, 2016 and April, 2017 ($n = 13$)

Lead author	Study site(s)	Intervention	Study design/ analytic approach	Primary aim	Primary outcome	Main findings	Limitations	Rationale for inclusion in review
Provider-targeted interventions:								
Claborn *et al.* [12]	Two northeastern sites, United States	CCI provider educational program for patients with HIV & substance use disorders comprising: mobile application for treatment providers, interagency communication protocol, & training protocol	Three-phase formative intervention design and feasibility testing (protocol)	To develop and test CCI for provider education to better coordinate HIV & substance abuse care	Establish feasibility and acceptability of a CCI & assessment procedures	N/A	Trial in progress	Insight into future modalities, as intervention planned to include mobile application tool for providers targeting care coordination
Gupta *et al.* [13]	Maharashtra (excluding Mumbai), India	Mobile-phone-based tracking & reminder system for providers to trace pregnant mothers living with HIV & HIV-exposed infants	Program design and pilot implementation report	Assess utility of web-based mobile monitoring tool, for tracking of HIV-exposed children for EID to 18 months.	Successful development & pilot test of mobile/ E-Mail reminder system to providers for EID	System designed for facility-entered records of HIV+ mothers & 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) at 6 weeks for DNA-PCR in the 12 months preceding and following pilot 18 months confirmatory HIV testing increased from 45.6% (934/2044) to 54.7% (1118/2044)	Bulk of article describes technical platform with no mention of provider training No solicitation of provider or patient feedback	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 & also note concerns surrounding confidentiality based on unique identifiers transferred from facility to central government office. Lack of provider training description and inputs from providers & patients RE actual utility limits potential application
Kang'a *et al.* [14▪]	Kenya	N/A	Cross-sectional program assessment	Evaluate how EMR platforms in Kenya in 2012 performed against national EMR standards	Measurement of specific EMR performance across seven review domains	EMRs scored highly (in descending order) in health information & reporting, security, system features, core clinical information, & order entry criteria; scored lowest against clinical decision support & interoperability criteria Key weakness identified as reduced ability to guide clinical decision-making (e.g., patient referral; managing drug interactions; exchanging clinical information & patient summaries; electronically prescriptions, laboratory orders, and results Four EMRs met 60.0% threshold: OpenMRS, IQ-Care, C-PAD & Funsoft	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	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
Kuehne & Keiller [15▪]	Cape Town, South Africa	Self-produced video clips of scripted provider-patient interactions for HIV-TB care watched via YouTube to augment clinical teaching in busy clinic	Learning intervention pilot test	Evaluate using self-produced video-clips to supplement face-to-face clinical teaching in a busy clinic	Student satisfaction and knowledge gain	Students found watching video clip on YouTube and then attending clinic visits and discussing case afterward acceptable and useful learning adjunct, but desired question and feedback session	Number of students tested & specific content & validation process of script not described	Model may present useful modality for in-service e-training, particularly if linked with providers for discussion following video view. Relies on sufficient Internet connectivity and provider possession of tablet or smartphone

Table 2 (*Continued*)

Lead author	Study site(s)	Intervention	Study design/ analytic approach	Primary aim	Primary outcome	Main findings	Limitations	Rationale for inclusion in review
Oluoch *et al.* [16▪▪]	Siaya Province, Kenya	CDSS sending alerts & clinical guidance to providers integrated within EMR	Prospective cluster randomized trial	Evaluate impact of CDSS within EMR vs. standard EMR info on ART failure identification & ART regimen change based on provider interaction	Difference between groups in proportion of patients experiencing ART treatment failure & had a documented clinical action	Of ART patients, 1125 (11%) in control & 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 (28–84; $P < 0.001$) and to ART initiation from first CD4 count was 6.8 vs. 12.1 months in intervention vs. control groups, respectively In 1445 cases, clinicians did not act on recommendation following an alert. In 1109 (77%) of cases, clinicians reported appropriate action had been taken, but not recorded in charts	Reliance of written test order/action entry on patient card to ensure within EMR Limited number of data entry clerks at facilities High turn-over of clinical staff, necessitating ongoing training cycles	Provider reminder/clinical guidance system housed within EMR represents novel approach & rigorous evidence supports associated improved patient HIV care outcomes.
Park *et al.* [17▪]	Botswana	Impact of Internet access to Wikipedia at no cost on health information use & access by providers	Qualitative program assessment	Identify clinical information needs of & perceptions of Wikipedia as clinical tool among HCWs	Themes surrounding current information sources, perceived utility, & clinical information needs	Current information compromised by limited Internet access at facilities due to infrastructure and other issues & limited confidence in other information resources (e.g., books, MoH publications) as many outdated Those with Internet access voiced uncertainty over which sites represented consistently reliable information; perceptions regarding reliability of Wikipedia split between skepticism & acceptance HIV content area gaps were management of viral CNS infections, ART adherence, ART side-effects/ interactions in pregnancy, & new testing guidelines	Lower-level health posts were under-represented in sampling Variations in IT literacy among provider participants	Efforts to improve health information access with popular sites are well intended but require provider buy-in on whether source is reliable & training in how best to use electronic information resources
Rettler *et al.* [18]	Massachusetts, United States	Integrated clinical alert system with EMR for HIV providers	Retrospective program report	Assess feasibility and function of consolidated MAVEN electronic system enhanced to document & triage clinic-level, laboratory-level, & patient-level surveillance, field epidemiology,& capture HIV care continuum data with provider alert feature	System implementation & function	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 & coding accuracy to ensure maximum capture & recognition of cases falling out of care to then sending a subsequent alert to clinic of origin	No feedback obtained from clinicians regarding whether alerts prompted action or user friendliness of MAVEN No patient outcome data (retention in HIV care cascade) or perceptions regarding whether quality of care improved	EMR system enhancement can include provider prompts & suggested clinical actions to optimize retention in HIV care cascade; models developed here & elsewhere would benefit from efficacy trials as technology becomes more robust
Waters *et al.* [19▪]	Mozambique	Tracking of provider in-service training & provider skills vs. facility needs within national health service	Retrospective program report	Document novel national HRIS approach & key success factors	System development, implementation, & strategic data use	System used to identify variety of HIV-related human resource issues, translatable to other fields of care: Availability of providers based on preservice enrollment & recent in-service training for HIV service capacity; Tracking of in-service training & supportive supervision received; ART/PMTCT trained nurses not consistently assigned to facilities providing those services	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	Scale-up of similarly robust HRIS systems will be useful adjunct to determining training needs & pairing with appropriate eHealth interventions for HIV care

Table 2 (*Continued*)

Lead author	Study site(s)	Intervention	Study design/ analytic approach	Primary aim	Primary outcome	Main findings	Limitations	Rationale for inclusion in review
Client-targeted interventions								
Bath *et al.* [20]	London, United Kingdom	Social media used to augment National HIV Testing Week	Retrospective program description	To describe impact of social and other media to increase outpatient HCT during National HIV Testing Week	Number patients accepting testing; number reached by Twitter	2402 (target 2500) OPD/A&E patients accepted testing 8 cases (3 new) detected 238 860 hits received on Twitter	Lack of provider evaluation of training quality or knowledge; Did not measure HCT refusal rate	Training emphasizes need for providers to learn & consider utilizing electronic/social media for patient outreach
Gibbs *et al.* [21]	England	Online system to provide diagnosis & initial care for patients in lieu of provider; provider-extender	Program design and pilot implementation report	Develop online management system for home-based results/ treatment of sexually-transmitted infection	Successful pilot-test of automated system providing results through medication dispensing	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	Tested only for bacterial STIs to date; Application to home-based HIV testing only proposed by authors Requires patient facility with/access to Internet	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
Technology Assessments/Reviews								
Njoroge *et al.* [22▪]	Kenya	N/A	Systematic literature review of 69 project publications & reports	Situational analysis of eHealth interventions implemented in Kenya	N/A	69% of projects involved mHealth with 25% overall projects focused on HIV; most were concentrated in Nairobi & 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 Only 41% of projects reported evaluation following implementation; 8 trials with efficacy data	No evaluated SMS project involved messaging/ education for HIV care providers Interventions tended to focus on one topical area or population & did not consider overall MoH health priorities	Review notable for small number of provider training/ education interventions (9%) & lack of evaluation overall, particularly with sufficient rigor, for all eHealth interventions. There were few eLearning & telemedicine interventions, reflecting potential need for provider-targeted intervention development & efficacy assessment of existing models
Posadzski *et al.* [23]	Multiple countries	N/A	Cochrane systematic review of 132 trials	Assess effects of unidirectional, bidirectional, & combination interventions using ATCS for preventing disease & managing long-term conditions on various clinical outcomes	Multiple health outcomes as specified in trials/ studies meeting inclusion criteria	Only 3/132 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 stated primary outcomes of decreased alcohol consumption at 12 months, decreased injecting drug use, or improved ART adherence	Few HIV care-related studies, possibly due to date cut-off at 2015	Authors concluded there was insufficient evidence to recommend ATCS interventions for improvement of HIV care extension for patient-provider contact. ATCS has potential as care extender by eliciting & facilitating follow-up information through automated system; consider application of successful models to aspects of HIV care
Yah *et al.* [24]	Multiple countries	N/A	Scoping review	Describe telemonitoring/ mHealth TB/HIV interventions potentially applicable to sub-Saharan Africa	N/A	General descriptions of traditional intervention models for HIV/TB community sensitization/ prevention, early diagnosis, prevalence monitoring, & tele-treatment for HIV/ TB, & immunization & matching with potential eHealth & telemedicine modalities	Immunization receives relatively less emphasis Sparse content on provider education interventions Did not follow standard review guidelines (PRISMA)	Review article focusing more on behavioral determinants of health outcomes & potential application of eHealth modalities to address them but limited matching with actual eHealth program models limits utility of this review

AOR, adjusted odds ratio; ATCS, automated telephone communication systems; CCI, Care coordination intervention; CDSS, Clinical decision support system; CI, confidence interval; eHealth, electronic health; CNS, central nervous system; EID, early infant diagnosis; EMR, electronic medical record; IT, information technology; HCT, HIV counseling and testing; HRIS, human resource information system; MAVEN, Massachusetts Virtual Epidemiologic Network; PRISMA, preferred reporting items for systematic reviews and meta-analyses; STI, sexually transmitted infection; TB, tuberculosis.

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

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

Lead author	Study site(s)	Intervention	Study design/ analytic approach	Primary aim	Primary outcome	Main findings	Limitations	Rationale for inclusion in review
Provider-targeted interventions								
Drummond *et al.* [25▪]	Three Southern states, United States	HITIDES project: depression collaborative care with enhanced usual care in HIV clinics. An offsite HIV depression care team (psychiatrist, a DCM, & clinical pharmacist) provided collaborative care & made recommendations to providers through EMR system. The DCM delivered care management through phone calls.	Multistage formative evaluation	Explore patient & provider satisfaction & challenges identified with HITIDES intervention	Thematic content surrounding patient & provider satisfaction & issues with telephone-administered mental health/ depression care	Nearly all providers & patients found off-site service helpful & desired to continue. Providers summarized 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	Quantitative results not summarized, though published previously Interviews conducted in 2007–2009 with change in care norms since that time Inclusion of only three facilities in interviews	One of few qualitative studies that explore human component of telemedicine & determine patient preferences to create sense of therapeutic alliance
Moeckli *et al.* [26▪▪]	West Coast (2) & Midwest (1) Veterans Administration health centers, United States	ECHO is a provider level telemedicine model whereby urban multispecialty care team conducts regular video conferencing with rural/ remote providers for in-service training & telemedicine consultation.	Mixed methods evaluation	Measure level of & contextual factors influencing uptake of HIV ECHO program	Quantitative: Proportion primary care clinics providing & proportion eligible veterans participating in program Qualitative: factors influencing program adoption & reach	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 & rural patients Program perceived positively by patients & providers but primary care providers felt many patient issues warranted referral rather than attempted remote management	Not conducting program in very rural/ isolated setting with no HIV care providers; Any patients or providers declining ECHO participation not interviewed	Study provides alternate perspective on ECHO program as implemented within US Veterans Administration with qualitative interviews from both provider groups to identify potential advantages & disadvantages
Montgomery *et al.* [27▪]	Lilongwe, Malawi	Video & online based telemedicine program for pathology consultation	Program report	Describe concordance in diagnosing lymphoproliferative disorders from pathology samples between telemedicine & US confirmatory groups	Concordance rate between real-time & confirmatory diagnoses & description of range of diagnosed conditions over first 2 years of program	Most cases were Burkitt's lymphoma, particularly in pediatric patients Discordance rates that would change clinical management 9 & 5% for cytology & fixed tissue slides, respectively 74 & 76% complete concordance for cytology & fixed-tissue samples between real-time (Malawian pathologists and telemedicine conference review) & US additional testing/assessment	Samples biased toward acute/aggressive cases as more likely referred to tertiary program site Low sample size Inability to confirm cytologic diagnoses in US	Telemedicine approach makes pathology services available in low-resource setting but at substantial cost (authors estimated US$200 000 at start-up for equipment & training) & relies on donated space & professional time; may not be feasible in all settings but serves as telemedicine model for other services for pathology or subspecialties where diagnosis/testing may be less costly
Tesfalul *et al.* [28▪]	Botswana	Smartphone use for photo & clinical information exchange for telemedicine program	Program report	Assess dental specialty telemedicine system's impact on patients' diagnoses & management plans	Need for specialist referral, concordance between diagnosis & management plans between remote provider & specialty team	23% (6/26) HIV prevalence among patients Discrepancies, sometimes large, in diagnosis & (more frequently) management plan of dental officer & specialists. Many were attributed to officer opting for specialist referral while specialist advised biopsy or biopsy & medication to obviate referral Overall need for specialist referral reduced by 52% with telemedicine system	Small sample size Lack of long-term follow-up of patients to ensure treatments appropriate &/or referrals completed	Relevant telemedicine model provides consultation for outlying providers remote from specialists & requires only mobile network access & smartphones

Table 3 (*Continued*)

Lead author	Study site(s)	Intervention	Study design/ analytic approach	Primary aim	Primary outcome	Main findings	Limitations	Rationale for inclusion in review
Wood *et al.* [29▪▪]	Washington & surrounding states, United States	ECHO is a provider level telemedicine model whereby urban multispecialty care team conducts regular video conferencing with rural/ remote providers for in-service training & telemedicine consultation	Program report	Describe clinical problems prompting remote consultation requests & evaluate changes in remote providers' self-assessed HIV care confidence & knowledge	Descriptive analysis of clinical problems; confidence in HIV care provision ability, feel part of HIV care community (pre/ post)	Between 2012–2015, provider response rate 50% (45/90) on annual program evaluation survey 172 sessions with 533 case presentations occurred, with mean weekly attendance of 26.1 providers; 40% in rural locations 14/19 care self-efficacy, overall HIV knowledge, & feeling of being part of HIV community of practice all increased significantly during program period	Low provider response rate with significant differences in program engagement between responders & nonresponders No inclusion of patient outcome measures or perceptions regarding quality of care	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.* [26▪▪] for alternate perspective
Patient-targeted interventions								
Reynolds *et al.* [30]	Belgaum, Karnataka & Bengaluru, India	Mobile Phone-Based Approach for Health Improvement, Literacy & Adherence (MAHILA) trial delivered by nurses for enhancing self-care & treatment adherence among HIV-infected women with depression symptoms	Randomized controlled pilot study (protocol)	Assess feasibility, acceptability, & preliminary efficacy of intervention	Planned outcomes include: antiretroviral treatment adherence (questionnaire & viral load), depressive symptoms (CES-D scores), illness perceptions, internalized stigma & quality of life	Mobile phone intervention delivered by nurses for up to 16 weeks. Calls are made by the nurse at baseline & >2×/week during weeks 1–4, weekly during weeks 5–10, & then at weeks 14 and 16. Script used to guide delivery of critical elements of intervention, but duration & content individualized to participant. Key components include: providing patient with individualized contextually congruent program; integrating screening for depression & other concurrent risk factors; enabling proactive problem solving to aid in overcoming factors that may impede treatment engagement; improving early recognition of barriers and referrals; & providing mediator (study nurse) between health system & participants. Clinical follow-up at baseline, 4, 12, 24 & 36 weeks postrandomization by blinded providers	Study to be implemented	Telemedicine model to address HIV & depression comorbidities while extending provider reach & informing providers of patient status between visits
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 and implementation of pilot telemedicine program in 'white space' bandwidth with increased 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 telemedicine use and holds great potential in settings where Internet connectivity is unreliable
Iribarren *et al.* [32▪]	N/A	N/A	Scoping review	Systematically compare text messaging platforms & summarize advantages & disadvantages	Functional features of platforms use for text-message 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 t 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/telemedicine programming.

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.

how specialists manage competing demands for guidance in urgent situations with their usual work and whether compensation becomes an issue. Other countries may wish to implement this model and, in doing so, may grapple with human resource issues on how to convene a consistently available expert panel.

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.

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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

1. Joint United Nations Programme on HIV/AIDS (UNAIDS). AIDS update 2016. Geneva: UNAIDS; 2016.
2. World Health Organization (WHO). Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection, recommendations for a public health approach. 2nd ed. Geneva: WHO; 2016.
3. WHO; International Telecommunication Union. National eHealth Strategy Toolkit. Geneva: WHO; 2012.
4. Duque J, Gaga S, Clark D, *et al.* Knowledge, attitudes and practices of South African healthcare workers regarding the prevention and treatment of influenza among HIV-infected individuals. PLoS One 2017; 12:e0173983.
5. Geibel S, Hossain SM, Pulerwitz J, *et al.* Stigma reduction training improves healthcare provider attitudes toward, and experiences of, young marginalized people in Bangladesh. J Adolesc Health 2017; 60:S35–S44.
6. Sunguya BF, Mlunde LB, Urassa DP, *et al.* Improving feeding and growth of HIV-positive children through nutrition training of frontline health workers in Tanga, Tanzania. BMC Pediatr 2017; 17:94.
7. ■■ Vasan A, Mabey DC, Chaudhri S, *et al.* Support and performance improvement for primary healthcare workers in low- and middle-income countries: a scoping review of intervention design and methods. Health Policy Plan 2017; 32:437–452.

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.

8. ■ Bassett IV, Coleman SM, Giddy J, *et al.* Sizanani: a randomized trial of health system navigators to improve linkage to HIV and TB care in South Africa. J Acquir Immune Defic Syndr 2016; 73:154–160.

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.

9. Kojima N, Krupp K, Ravi K, *et al.* Implementing and sustaining a mobile medical clinic for prenatal care and sexually transmitted infection prevention in rural Mysore, India. BMC Infect Dis 2017; 17:189.
10. Ambia J, Mandala J. A systematic review of interventions to improve prevention of mother-to-child HIV transmission service delivery and promote retention. J Int AIDS Soc 2016; 19:20309.
11. ■ Ma Q, Tso LS, Rich ZC, *et al.* Barriers and facilitators of interventions for improving antiretroviral therapy adherence: a systematic review of global qualitative evidence. J Int AIDS Soc 2016; 19:21166.

This systematic review article is important as it summarizes provider perspectives surrounding task shifting to extend HIV care. This article is important as it is a review of qualitative evidence and portrays a high degree of acceptability of HIV care task-shifting to lay workers in low-income and middle-income countries.

12. Claborn K, Becker S, Ramsey S, *et al.* Mobile technology intervention to improve care coordination between HIV and substance use treatment providers: development, training, and evaluation protocol. Addict Sci Clin Pract 2017; 12:8.

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14. ■ Kang'a S, Puttkammer N, Wanyee S, *et al.* A national standards-based assessment on functionality of electronic medical records systems used in Kenyan public-sector health facilities. Int J Med Inform 2017; 97:68–75.

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.

15. ■ Kuehne J, Keiller L. African answers to African problems using mobile technology. Med Educ 2016; 50:571–572.

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.

16. ■■ Oluoch T, Katana A, Kwaro D, *et al.* Effect of a clinical decision support system on early action on immunological treatment failure in patients with HIV in Kenya: a cluster randomised controlled trial. Lancet HIV 2016; 3:e76–e84.

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.

17. ■ Park E, Masupe T, Joseph J, *et al.* Information needs of Botswana healthcare workers and perceptions of Wikipedia. Int J Med Inform 2016; 95:8–16.

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 accurate, vetted information and resources for acute consultations.

18. Rettler H, Klevens M, Haney G. Building health IT capacity to improve HIV infection health outcomes. Am J Manag Care 2016; 22:821–825.

19. ■ Waters KP, Mazivila ME, Dgedge M, *et al.* eSIP-Saúde: Mozambique's novel approach for a sustainable human resources for health information system. Hum Resour Health 2016; 14:66.

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.

20. Bath R, O'Connell R, Lascar M, *et al.* TestMeEast: a campaign to increase HIV testing in hospitals and to reduce late diagnosis. AIDS Care 2016; 28:608–611.

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22. ■ Njoroge M, Zurovac D, Ogara EA, *et al.* Assessing the feasibility of eHealth and mHealth: a systematic review and analysis of initiatives implemented in Kenya. BMC Res Notes 2017; 10:90.

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.

23. Posadzki P, Mastellos N, Ryan R, *et al.* Automated telephone communication systems for preventive healthcare and management of long-term conditions. Cochrane Database Syst Rev 2016; 12:CD009921.

24. Yah CS, Tambo E, Khayeka-Wandabwa C, Ngogang JY. Impact of telemonitoring approaches on integrated HIV and TB diagnosis and treatment interventions in sub-Saharan Africa: a scoping review. Health Promot Perspect 2017; 7:60–65.

25. ■ Drummond KL, Painter JT, Curran GM, *et al.* HIV patient and provider feedback on a Telehealth Collaborative Care for depression intervention. AIDS Care 2017; 29:290–298.

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

26. ■■ Moeckli J, Stewart KR, Ono S, *et al.* Mixed-methods study of uptake of the extension for community health outcomes (ECHO) telemedicine model for rural veterans with HIV. J Rural Health 2016; doi: 10.1111/jrh.12200. [Epub ahead of print]

One of two important articles presenting data from an HIV telemedicine 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 telemedicine program was underutilized over time.

27. ■ Montgomery ND, Liomba NG, Kampani C, *et al.* Accurate real-time diagnosis of lymphoproliferative disorders in Malawi through clinicopathologic teleconferences: a model for pathology services in sub-Saharan Africa. Am J Clin Pathol 2016; 146:423–430.

This article describes a pathology telemedicine 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.

28. ■ Tesfalul M, Littman-Quinn R, Antwi C, *et al.* Evaluating the potential impact of a mobile telemedicine system on coordination of specialty care for patients with complicated oral lesions in Botswana. J Am Med Inform Assoc 2016; 23:e142–e145.

This article describes a telemedicine 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.

29. ■■ Wood BR, Unruh KT, Martinez-Paz N, *et al.* Impact of a Telehealth Program that delivers remote consultation and longitudinal mentorship to community HIV providers. Open Forum Infect Dis 2016; 3:ofw123.

The second of two articles describing a telemedicine 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.

30. Reynolds NR, Satyanarayana V, Duggal M, *et al.* MAHILA: a protocol for evaluating a nurse-delivered mHealth intervention for women with HIV and psychosocial risk factors in India. BMC Health Serv Res 2016; 16:352.

31. ■■ Chavez A, Littman-Quinn R, Ndlovu K, Kovarik CL. Using TV white space spectrum to practice telemedicine: a promising technology to enhance broadband internet connectivity within healthcare facilities in rural regions of developing countries. J Telemed Telecare 2016; 22:260–263.

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

32. ■ Iribarren SJ, Brown W 3rd, Giguere R, *et al.* Scoping review and evaluation of SMS/text messaging platforms for mHealth projects or clinical interventions. Int J Med Inform 2017; 101:28–40.

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