

Does Quality of Care Differ When HIV Patients Are Treated by Non-Specialist and Specialist HIV Healthcare Providers in Developed Countries? A Systematic Narrative Review

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Abstract

Introduction: In developed countries, HIV care is mostly provided by trained specialist healthcare professionals. Due to the increasing demand for HIV care, pressure on healthcare providers to reduce cost and the current global economic constraints, many developed countries are searching for alternative HIV care models. This review aims to consider whether HIV treatment and care can be provided as effectively and safely by doctors and nurses with no HIV-specialist training compared to those with HIV-specialist training. **Methods:** Three electronic bibliographic databases MEDLINE, EMBASE and the Cochrane Library were searched for studies conducted between January 1996 and March 2015. Manual searches of reference lists of all relevant reports retrieved from the electronic databases were conducted. All comparative studies examining the quality of HIV care provided by different types of healthcare providers in developed countries were included. **Results:** Nine observational studies involving 27,015 patients were included in the review. Eight studies were conducted in the USA and one study in Switzerland. Healthcare providers with HIV-related expertise and or training and those without HIV-related expertise or training who collaborated with providers with HIV-related expertise and or training outperformed other healthcare providers in many virological, immunological and ART-related outcomes. **Conclusion:** This review found moderate quality evidence that HIV care can be provided effectively by non-HIV spe-

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cialists if they have access to HIV specialists or experts for advice and support.

Keywords

HIV/AIDS, Healthcare Providers, Quality of Care, Developed Countries, Systematic Review

1. Introduction

In the last two decades, the availability and wide use of combination antiretroviral therapy (cART) in developed countries has enabled people living with HIV/AIDS (PLWHA) to live increasingly longer and healthier lives. PLWHA who start cART early are expected to receive treatment for up to 50 years [1]-[3]. Care of PLWHA in developed countries is mainly provided by clinicians and nurses who have expertise in HIV medicine in specialist care centres. For instance, in the USA and the United Kingdom, patients who are diagnosed with HIV are referred to infectious disease or HIV specialists for further care and treatment. Yet, as more PLWHA are diagnosed and treated the need for these providers will increase. However, due to the current economic constraints in many developed countries, the present treatment model of mainly relying on HIV specialists for care and treatment of PLWHA will make it more difficult to respond to the increasing demand of HIV care. In order to sustain the gains achieved in the fight against HIV/AIDS, an alternative model of care is needed to help offset the anticipated burden on the current healthcare systems while maintaining the same high quality of HIV care.

Currently, some low- and middle-income countries (LMICs) have turned to models of care such as task-shifting and decentralisation of HIV care [4] [5]. Decentralisation of HIV care outside of the hospital settings provided by non-HIV specialists has also been implemented in other LMICs and found to be as beneficial as HIV care provided in hospital settings [6].

In developed countries very few studies have examined the effectiveness of task shifting of HIV care to meet the needs of the increasing number of PLWHA and offset the rising costs of care. This systematic literature review aims to report on the evidence of the quality of HIV care provided by different types of healthcare professionals in developed countries in the cART era.

2. Methods

Protocol for this review was developed *a priori* following the methodology outlined by the Centre for Reviews and Dissemination [7].

2.1. Study Inclusion and Exclusion Criteria

Randomized and controlled clinical trials, cohorts, case control, cross-sectional studies and interrupted time series with comparison groups that investigated the quality of HIV care provided by different types of healthcare professionals were included in this review. Editorials, comments, letters, clinical guidelines or reviews were excluded. For this review, healthcare providers were defined as health professionals providing medical and nursing care and not ancillary care to PLWHA. HIV specialists were defined as clinicians who have received specialised HIV training from accredited institutions or those who have self-identified as HIV specialists. Studies that involved healthcare providers who provided ancillary or social care were excluded. Because treatment and care of PLWHA has evolved rapidly, only studies that were carried out from 1996 onwards when cART became widely and readily available in developed countries were considered.

All PLWHA aged 18 or older receiving antiretroviral therapy (ART) were included. Participants who required specialty care services other than for their HIV (e.g. adults with mental illnesses) were excluded. Study settings were developed countries classified as members of the Organization for Economic Cooperation and Development (OECD) in 2014 as these countries are socioeconomically comparable and have healthcare systems that are fairly representative of other developed nations.

Commonly measured outcomes in HIV clinical care studies were employed to assess the quality of HIV care [8] including reduction in HIV viral load; CD4 cell count; use of ART; hospitalization and length of hospital stay; use of appropriate prophylaxis; adherence to ART; appropriate screenings and vaccinations; patient satis-

faction of care; and non-HIV related interactions due to HIV care and treatment.

2.2. Search Strategy

MEDLINE, EMBASE and the Cochrane Library [9] were systematically searched for studies published between 1996 and 2015 limiting to English articles only.

A robust search strategy was developed using relevant text words and MeSH or Emtree headings for health-care providers, clinicians, doctors, nurses, HIV/AIDS, ART, OECD countries, which were combined by using Boolean operators such as “AND” and “OR”.

Additional articles were identified by hand searching the reference lists of all relevant texts. All citations were imported into Refworks bibliographical manager.

2.3. Data Extraction and Analysis

BS, EO and IT screened the titles and abstracts of all the citations to identify potentially eligible articles using *a priori* inclusion and exclusion criteria. The three authors independently screened and critically appraised the full-text reports of all potentially eligible studies using a piloted eligibility checklist. Data were then extracted from all eligible studies using a piloted data extraction form adapted from the Cochrane Collaboration guidelines [10]. Disagreements were discussed and resolved through consensus. A narrative synthesis of data was carried out as a meta-analysis was not appropriate due to the heterogeneity of the included studies.

2.4. Quality Assessment/Risk of Bias

BS and EO independently assessed the quality of the included studies using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies [11]. The tool assesses studies against selection bias, study design, confounders, blinding, data collection methods, attrition, intervention integrity and data analyses, which it provides “strong”, “moderate” or “weak” quality rating. Potential important confounding variables such as patients’ age, sex, race/ethnicity and case mix that were identified in other HIV intervention studies were also evaluated [12] [13]. Uncertainties in quality assessment were resolved through arbitration with another reviewer (IT).

3. Results

3.1. Search Results

2,327 citations from electronic searches and 65 additional reports from manual search of the reference lists of relevant reports were identified. After removing duplicates and irrelevant reports, nine studies with 27,015 participants were included in the review. The majority of the excluded reports were review articles or studies that focused on care settings rather than healthcare professionals. **Figure 1** shows the PRISMA flow diagram.

3.2. Characteristics of Included Studies

The characteristics and findings of the nine included studies are summarized in **Table 1**. All nine studies were non-randomized studies: two were retrospective cohort studies [14] [15], four were prospective cohort studies [16]-[19] and three were cross-sectional studies [20]-[22].

All but one of the included studies were carried out in the USA. The non-USA study was conducted in Switzerland. Eight studies were conducted in outpatient settings [14]-[18] [20]-[22] and one study was carried out in an inpatient hospital setting [19]. Two of the studies in the USA were conducted in a treatment network in New York [14] and California [15], three were conducted with patients within existing research studies across the 48 contiguous states [16] [19] [21], two were done in federally funded HIV clinics across the USA [18]-[22] and one was done using public and medical records of women receiving government medical care benefits in New York [20]. The Swiss study was conducted in a teaching outpatient clinic and general practices in urban Zurich [17].

There was considerable variation across the studies in terms of definition and training of the different HIV care providers such as infectious disease (ID), HIV experts, HIV specialists, and generalist; and the comparisons

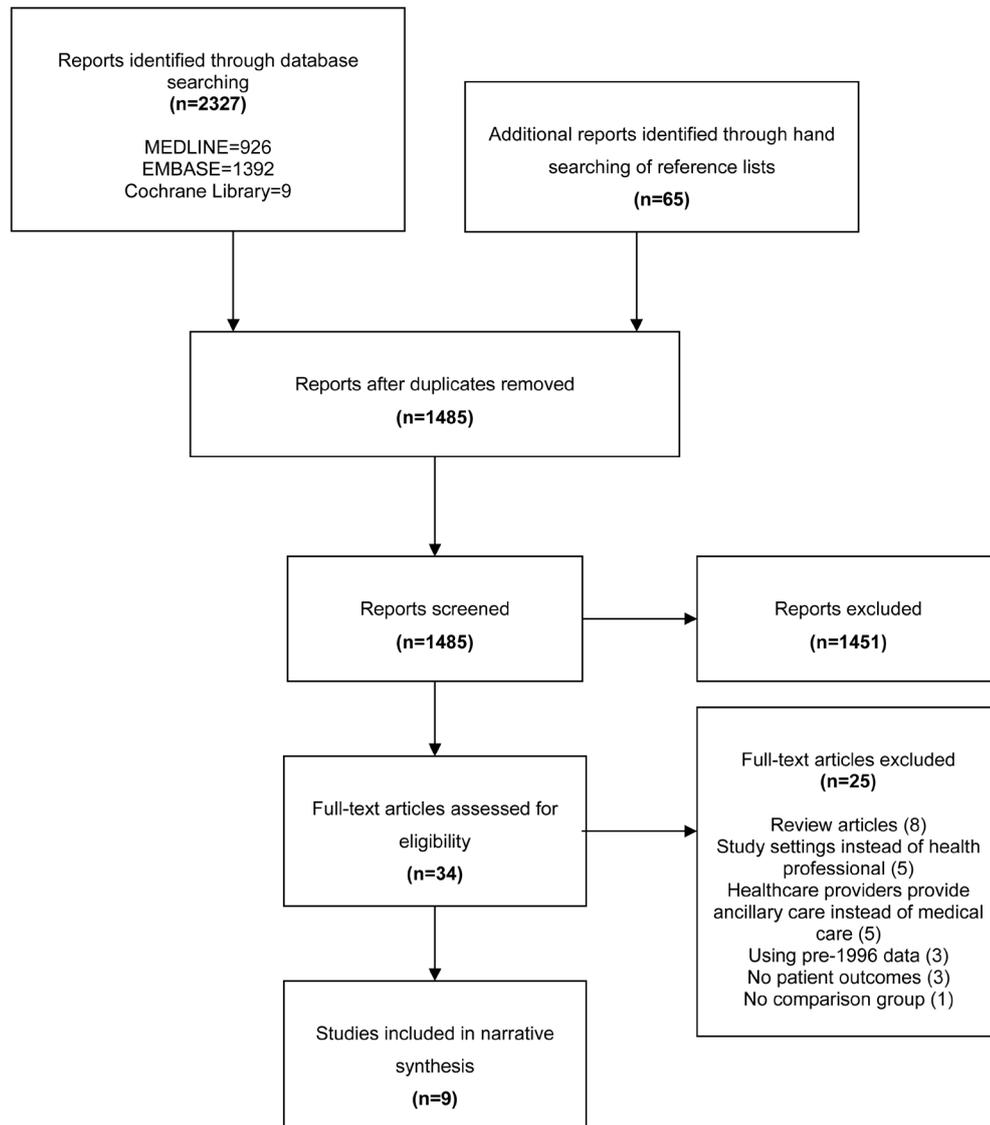


Figure 1. Study selection flow diagram.

between these different providers.

3.3. Quality Assessment

Five studies were considered to have “strong” overall quality rating [14]-[18], while three studies were rated “moderate” [19] [20] [22] and one study was rated “weak” [21] (Table 2).

All of the included studies controlled for at least four of the six important confounding variables: age, sex, race/ethnicity, HIV risk, insurance status and case mix (Table 3).

3.4. Reported Outcomes

Twenty-five different outcomes were reported across the nine studies (Table 4).

3.4.1. Viral Load

Five studies [14] [15] [17] [18] [22] measured viral load; of which, three studies show significant differences in viral loads depending on the care provided by different healthcare personnel.

Table 1. Summary of included studies' characteristics and findings.

Author/ Publication year	Country	Study Design	Study population/ setting	Intervention		Outcomes		Notes	
Chu 2010 (14)	New York, USA	Retrospective cohort study. Data collected for years 2005-2008	Non-pregnant HIV positive adults 18+ years on cART in community-based primary care network (CB) (n = 178) vs. a large tertiary care center and teaching hospital (HB) (n = 237)	CB: non-HIV-expert PCP in collaboration with accredited HIV specialists (all general internal/family medicine-trained) vs. HB: ID-trained clinicians	VL	CB	adj OR 1.22, 95% CI 0.41 to 3.63.	Fewer patients initiating cART than needed for statistical significance. Data were adjusted for patients' characteristics.	
					CD4 count	HB	adj OR 0.76, 95% CI 0.47 to 1.21		
Gardner 2002 (21)	USA	Cross-section al analysis. Data collected for years 1998-1999	HIV-infected women (n = 273)	HIV-specialist care vs. non-HIV-specialist care.	ART use	HIV-specialist	-CD4 cell count < 200 (<i>P</i> = 0.6) -CD4 cell count 200 - 500 (<i>P</i> ≤ 0.001) -CD4 cell count > 500 (<i>P</i> = 0.45) -All CD4 cell count groups (<i>P</i> < 0.001)	Self-reported use of ART. Analysis for use of ART was adjusted for significant predictors that led women to use HIV-specialist care. Provider type based on self-report by patients. Data on types of ART use were adjusted for patients' characteristics. All other data, no adjustment was stated.	
					PJP	Non-HIV-specialist	-CD4 cell count < 100/mm ³ (<i>P</i> = 0.19)		
Horberg 2012 (15)	California, USA	Retrospective cohort analysis. Data collected for years 1996-2006	HIV-infected patients initiating a new cART regimen (n = 7,071) or initiating a second or later cART (n = 3730) in an integrated healthcare system	Non-ID/non-HIV- expert PCP vs. non-ID but HIV-expert PCP vs. ID specialists vs. HIV-trained NP/PA	VL	Non-ID/ non-HIV expert	Undetectable at 12 months in: -ART-naïve patients (adj <i>P</i> = 0.36) -ART-experienced patients (adj <i>P</i> = 0.80)	All data were adjusted for clustering effect and patients' characteristics. Clinicians with more HIV caseload (adj <i>P</i> = 0.03) and experience (adj <i>P</i> = 0.003) was significant in VL success after 12 months of cART initiation among ART-naïve patients but not ART-experienced patients (caseload: adj <i>P</i> = 0.96; experience: adj <i>P</i> = 0.98).	
					ART adherence	ID specialist	-ART-naïve patients (adj <i>P</i> = 0.97) -ART-experienced patients (adj <i>P</i> = 0.66)		
Landon 2003 (16)	USA	Prospective cohort study. Data collected for years 1998-1999	Non-institutionaliz ed HIV patients participating in a research study (n = 1820).	ID-trained physicians vs. GM HIV-expert physicians vs. GM non-HIV-expert physicians	Appropriate cART therapy at 12 & 18 months after first protease inhibitor approval	ID physician	GM HIV-expert	GM non-H IV expert	All data were adjusted for patients' characteristics.

Continued

					ID physician	HIV-expert	Non-HIV-expert		
Landon 2005 (18)	USA	Prospective cohort study. Data collected for years 2000-2005	HIV patients age 18+ in federally funded HIV clinics (community health centers, community-based organisations, health departments, hospital outpatient clinics, university medical centers) (n = 5247).	ID physicians vs. (HIV-expert) GM physicians vs. (non-HIV-expert) GM physicians	cART therapy	ID physicians and HIV-expert GM vs. non-HIV-expert GM, 80% vs. 73% ($P < 0.001$)		After controlling for specialty training, caseload and knowledge, non-HIV-expert GM's overall quality of care is lower than ID physicians and HIV-expert GM (adj $P = 0.02$). Caseload differences not statistically significant. All data were adjusted for patients' characteristics.	
					VL control	ID physicians (41%) vs. HIV-expert GM (39%) vs. non-HIV-expert GM (31%) ($P = 0.01$)			
					Flu vaccination rate	ID physicians (54%) vs. HIV-expert GM (49%) vs. non-HIV-expert GM (41%) ($P < 0.01$)			
					PJP, PPD, HCV, Pap smear	No statistical significant difference			
					Outpatient visit	ID physicians (66%) vs. HIV-expert generalists (69%) vs. non-HIV-expert generalists (57%) ($P < 0.01$)			
						GP	ID	Shared care	Significance
					Median CD4 count	459 cells/ μ l (range: 120 - 1442)	449 cells/ μ l (79 - 891)	303.5 cells/ μ l (104 - 751)	No
					% of patients with VL < 400 copies/ml	72.1%	74.2%	87.5%	No
Page 2003 (17)	Zurich, Switzerland	Prospective cohort study. Data collected for years 1999-2001	HIV patients on ART receiving care in an urban area in general practices vs. a specialized university outpatient clinic (n = 106)	GP vs. ID specialists vs. shared care between GP and ID specialists.	Mean quality of life of all participants	129.5 \pm 22.5 baseline, 131.6 \pm 25.6 at study end		No	* = Data measured at baseline only. No adjustment was made because patients in all healthcare provider groups had similar baseline characteristics.
					Mean patient satisfaction*	Patients with GP and shared care are more satisfied than those with ID specialists		$P < 0.05$	
					ART use	No statistical significant difference			
					Patient's evaluation of providers	GP received statistically significantly higher mean scores for many dimensions of care (such as competence, information, communication, time and trust) than ID specialists.			
					Mean rate of ART adherence	No statistical significant difference			
					In-hospital mortality rate	adj $P = 0.38$		Readmission rates, emergency department visits and health status were self-reported. No clear descriptions of hospitalists and non-hospitalists besides the amount of time they spend in GM inpatient care. All data were adjusted for patients' characteristics, physicians' experience, care sites and time of hospital admission.	
					6-month mortality rate	adj $P = 0.57$			
					30-day readmission rate	adj $P = 0.99$			
					30-day emergency department visit rate	adj $P = 0.70$			
					30-day reported health	adj $P = 0.97$			
					Overall patient satisfaction	adj $P = 0.98$			

Continued

					Length of hospital stay	adj <i>P</i> = 0.13		
					Total hospital costs	adj <i>P</i> = 0.4		
					Inpatient medical doctor coordination with PCP	adj <i>P</i> = 0.87		
					Pain controlled during hospitalization	adj <i>P</i> = 0.55		
					Patient understanding of reasons for hospitalization	adj <i>P</i> = 0.20		
					PJP vaccination during hospitalization	adj <i>P</i> = 0.99		
							HIV-focused	Non-HIV-focused
Turner 2001 (20)	New York, USA	Cross-sectional analysis. Data collected for years 1996-1998	HIV women receiving federal medical care benefits (n = 595).	HIV-focused care (providers paid at enhanced rates to deliver HIV-related services or in an HIV-related specialty) vs. non-HIV-focused care	ART use	-Compared to patients with 0 visit to HIV-focused care, patients with 1 - 2 HIV-focused visits were statistically significant (adj <i>P</i> = 0.02) in receiving more acceptable ART combination and not significant (adj <i>P</i> = 0.61) in receiving cART. -Patients without clinical AIDS benefit from a greater visit to HIV-focused care in being prescribed cART compared to those with AIDS (adj <i>P</i> = 0.02) -Among women without AIDS, greater visits to HIV-focused care were more likely to be prescribed cART (adj OR 1.62, 95% CI 1.10 to 2.40) than those without HIV-focused care		Participants excluded due to small sample size: Asian Americans, American Indians and those who lack data on racial/ethnic group or maternal country of birth. All data were adjusted for clustering effect, patients' and care sites' characteristics.
							ID physician	HIV-expert GM
								Non-HIV-expert GM
								NP/PA
Wilson 2005 (22)	USA	Cross-sectional analysis. Data collected for years 1999-2001	Persons with HIV or AIDS in federally funded HIV care sites in 30 states (n = 6551).	ID-trained physicians vs. HIV-expert GM vs. non-HIV-expert GM vs. HIV-trained NP/PA	cART use, viral load control, influenza vaccine use, and outpatient visit rates	NP/PA performed better than non-HIV-expert GM (<i>P</i> < 0.05), but similar to ID-trained physicians and HIV-expert GM: -HIV-trained NP/PA outperformed non-HIV-expert GM in virological success (adj <i>P</i> = 0.012) but not ID physicians (adj <i>P</i> = 0.31) and HIV-expert GM (adj <i>P</i> = 0.86) -No difference in cART use between ID physician (adj <i>P</i> = 0.29) and HIV-expert GM (adj <i>P</i> = 0.58) compared to NP/PA. Low cART use in non-HIV-expert GM (adj <i>P</i> = 0.041) compared to NP/PA -NP/PA had higher rate of influenza vaccination than non-HIV-expert GM (adj <i>P</i> = 0.02) -Compared to NP/PA, no difference in outpatient visits in ID physicians (adj <i>P</i> = 0.125) and HIV-expert GM (adj <i>P</i> = 0.59) compared to NP/PA but low outpatient visits in non-HIV-expert GM (adj <i>P</i> < 0.001)		All data were adjusted for clustering effect, study sites, time of intervention and patients' characteristics.

Continued

PJP prophylaxis and HCV testing	NP/PA vs. GM physicians no statistical significant difference
PPD testing	Compared to NP/PA (rate = 0.63), ID physicians (rate = 0.53; adj <i>P</i> = 0.007), HIV-expert GM (rate = 0.47; adj <i>P</i> < 0.001) and non-HIV-expert GM (rate = 0.49; adj <i>P</i> = 0.007)
Pap smear testing	Compared to NP/PA (rate = 0.71), ID physicians (rate = 0.56; adj <i>P</i> = 0.001), HIV-expert GM (rate = 0.62; adj <i>P</i> = 0.025) and non-HIV-expert GM (rate = 0.52; adj <i>P</i> = 0.004)

Notes: Adj = Adjustment or adjusted. ART=Antiretroviral therapy. cART = Combination antiretroviral therapy. CI = Confidence interval. GM = General medicine. GP = General practitioners. HCV = Hepatitis C virus. HIV = Human immunodeficiency virus. ID = Infectious disease. NP = Nurse practitioners. OR = Odds ratio. *P* = *P*-value. PA = Physician assistants. PCP = Primary care providers. PJP = *Pneumocystis jiroveci* pneumonia. PPD = Purified protein derivatives. USA = United States of America. VL = Viral load. In all included studies, the level of statistical significance was set at 5%, with a *p*-value of ≤0.05 indicating a statistically significant result.

Table 2. Summary of the quality assessment of the included studies*.

Study	Minimizing selection bias ¹	Study design ¹	Control of confounders ¹	Blinding ¹	Data collection methods ¹	Attrition ¹	Overall rating ²
Chu 2010 (14)	Moderate	Moderate	Strong	Moderate	Strong	Strong	Strong
Gardner 2002 (21)	Strong	Weak	Strong	Moderate	Weak	NA	Weak
Horberg 2012 (15)	Strong	Moderate	Strong	Moderate	Strong	NA	Strong
Landon 2003 (16)	Moderate	Moderate	Strong	Moderate	Strong	Strong	Strong
Landon 2005 (18)	Moderate	Moderate	Strong	Moderate	Strong	Strong	Strong
Page 2003 (17)	Moderate	Moderate	Strong	Moderate	Strong	Strong	Strong
Schneider 2008 (19)	Moderate	Moderate	Strong	Moderate	Strong	Weak	Moderate
Turner 2001 (20)	Moderate	Weak	Strong	Moderate	Strong	Strong	Moderate
Wilson 2005 (22)	Moderate	Weak	Strong	Strong	Strong	NA	Moderate

Notes: *Quality of the study was assessed using the effective public health practice project quality assessment tool for quantitative studies (11). NA = Not applicable. ¹Overall rating: “Strong” = no weak rating, “Moderate” = 1 weak rating and “Weak” = ≥2 weak ratings on the different components of EPHPP Tool. ²Parameters assessed: minimization of selection bias: strong, the participants were likely; moderate, somewhat likely; weak, not likely, to represent the target population. Study design: strong, randomization occurred, e.g. RCTs; moderate, study described as case control, before and after, etc.; weak, study design not specified. Confounders: strong, controlled for all relevant confounders; moderate, controlled for some confounders; weak, control for confounders not specified. Blinding: strong, the researchers do not know participants’ intervention group and the participants do not know the research question; moderate, the researchers do not know participants’ intervention status or the participants do not know the research question or blinding is not stated in the article; weak, the researchers know participants’ intervention group and the participants know the research hypothesis. Data collection method: strong, valid and reliable data collection tools; moderate, tools valid but not reliable; weak, validity and reliability not described. Withdrawals and dropouts (attrition): strong, reported withdrawals and dropouts (80% - 100% of participants completed the study); moderate, reported withdrawals and dropouts (60% of participants completed the study); weak, withdrawal and dropout rates not specified.

Table 3. Summary of potential confounders controlled for in the included studies.

Study	Potential confounders controlled for in the study					
	Age	Sex	Race/ethnicity	HIV risk	Insurance status	Case mix
Chu 2010 (14)	Yes	Yes	Yes	Yes	Yes	Yes
Gardner 2002 (21)	Yes	NA	No	Yes	Yes	Yes
Horberg 2012 (15)	Yes	Yes	Yes	Yes	NA	Yes
Landon 2003 (16)	Yes	Yes	Yes	Yes	Yes	Yes
Landon 2005 (18)	Yes	Yes	No	No	NA	Yes
Page 2003 (17)	NA—same baseline characteristics for patients in different intervention arms					
Schneider 2008 (19)	Yes	Yes	Yes	No	Yes	Yes
Turner 2001 (20)	Yes	NA	Yes	No	NA	Yes
Wilson 2005 (22)	Yes	Yes	No	Yes	NA	Yes

Note: NA = Not applicable.

Table 4. Summary of included studies' outcome measurements.

Study	Outcome Measures																									
	Viral load	CD4 count	cART selection	Medical advice for ART	cART use	PJP prophylaxis	PPD testing	HCV screening	Pap smear	Flu vaccine	In hosp mortality	6month mortality	30day readmission	30day ER use	Hospital stay	Hospital cost	Inpatient coordination	Pain control	Understanding hospitalization	Quality of life	30 day reported health status	Patient satisfaction	Patient evaluation	ART adherence	OP visit	
Chu 2010 (14)	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Gardner 2002 (21)	N	N	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Horberg 2012 (15)	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Landon 2003 (16)	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Landon 2005 (18)	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
Page 2003 (17)	Y	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Schneider 2008 (19)	N	N	N	N	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	
Turner 2001 (20)	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Wilson 2005 (22)	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y

Notes: "Y" = Measurement included in the study. "N" = No measurement. ART = Antiretroviral therapy; cART = Combination antiretroviral therapy; ER = Emergency room; HCV = Hepatitis C virus; HIV = Human immunodeficiency virus; OP = Outpatient; PJP = *Pneumocystis jiroveci* pneumonia; PPD = Purified protein derivatives.

In the study by Horberg *et al.* [15], while there was no statistical difference in virologic success between ART-naïve ($P = 0.36$) and ART-experienced patients ($P = 0.80$) treated by non-infectious diseases (ID)/non-HIV-expert primary care providers (PCP), non-ID/HIV-expert PCP, ID specialists and HIV-trained nurse practitioner (NP) or physician assistant (PA) after 12 months of cART initiation, more ART-naïve patients under clinicians with more HIV caseload ($P = 0.03$) and HIV experience ($P = 0.003$) were able to achieve virologic success.

Landon *et al.*, [18] observed that ID physicians and HIV-expert generalists were better at controlling patients' viral load than non-HIV-expert generalists ($P < 0.001$). After controlling for providers' specialty training, HIV caseload and knowledge, the study still showed that patients under non-HIV-expert generalists had lower rates of virologic success than other clinicians within the study. However, the study found no significant difference in the outcome between the different clinicians when looking at HIV caseload alone.

Additionally, Wilson and colleagues [22] found that HIV-trained NP and PA performed better in viral load control than non-HIV-expert generalists, but comparable to ID physicians and HIV-expert generalists.

3.4.2. CD4 Cell Count

Two studies [14] [17] measured CD4 cell count. Chu *et al.*, [14] found no significant difference in achieving immunologic success among patients cared for by non-HIV-expert PCP in collaboration with HIV specialists and ID clinicians with NP or PA (OR = 0.76, 95% CI 0.47 to 1.21). Page *et al.*, [17] also found no statistical difference in the median CD4 cell count between patients cared for by general practitioner (GP) actively treating HIV patients in their practices, ID specialists and those in shared care (*i.e.* patients who were seeing both specialists and GP at the same time) over a one-year period.

3.4.3. Antiretroviral Therapy

Seven studies [14] [16]-[18] [20]-[22] measured various ART-related outcomes such as selection of cART and medical advice for ART.

Two studies found that patients cared for by clinicians without HIV-related training or experience were less likely to be on cART (OR = 0.32, 95% CI 0.17 to 0.61), [16] and less likely to receive cART ($P < 0.001$), [18] when compared to clinicians with HIV-related training and experience and/or clinicians without HIV-related training and experience collaborating with those with HIV-related expertise.

Furthermore, Wilson *et al.*, [22] observed lower cART use among patients under non-HIV-expert generalists when compared to those under HIV-trained NP and PA, who had similar rate of cART use as HIV-expert generalists' and ID physicians' patients.

Turner *et al.*, [20] reported that women with HIV-focused care visits, defined as visits to clinicians who were paid at a higher rate to provide HIV-related services or those in an HIV-related specialty were more likely to receive acceptable ART combinations than those not receiving any HIV-focused care (Table 1). However, when stratifying patients into those with AIDS and those without, the study authors found that women without AIDS benefitted from greater visits to HIV-focused care than those with AIDS ($P = 0.02$). Nonetheless, among women without AIDS, three or more HIV-focused care visits was associated with appropriate cART use compared to those without HIV-focused care visit (OR = 1.62, 95% CI 1.10 to 2.40).

Similarly, Gardner *et al.*, [21] observed that more patients who self-reported to attend HIV-specialist clinics received advice to begin ART ($P < 0.001$) and received appropriate cART and non-cART (monotherapy or combination ART without protease inhibitor or non-nucleoside reverse transcriptase inhibitor) ($P < 0.001$) than those attending non-HIV-specialist clinics. Yet, the level of significance was only observed in patients with CD4 cell count between 200 and 500 cells/mm³ ($P < 0.001$ and $P = 0.009$, respectively). In this study, attending HIV specialist clinics did not necessarily mean that patients received care from HIV specialists.

3.4.4. Opportunistic Infection Prophylaxis

Four studies, [18] [19] [21] [22] had outcome measurements associated with opportunistic infection prophylaxis.

All four studies measured the use of *Pneumocystis jiroveci pneumonia* (PJP) prophylaxis and found no differences in its use between ID physicians, HIV-expert generalists and non-HIV-expert generalists [18]; hospitalists and non-hospitalists ($P = 0.99$) [19]; HIV-specialist and non-HIV-specialist clinics for women who had CD4 cell counts less than 100 cells/mm³ ($P = 0.19$) [21]; and ID physicians, HIV-expert generalists, non-HIV-expert generalists and HIV-trained NP or PA [22].

Two studies measured hepatitis C screening but did not find any difference between ID physicians, HIV-expert generalists and non-HIV-expert generalists [18], and ID physicians, HIV-expert generalists, non-HIV-expert generalists and HIV-trained NP or PA [22].

Additionally, Landon *et al.*, [18] did not find any difference in the use of purified protein derivatives (PPD) testing for tuberculosis, hepatitis C screening and Pap smear among different clinicians. However, the study authors found that ID physicians and HIV-expert generalists significantly provided more influenza vaccination to their patients than non-HIV-expert generalists ($P < 0.01$).

Wilson *et al.*, [22] however found that HIV-trained NP or PA outperformed ID physicians, HIV-expert generalists and non-HIV-expert generalists in PPD testing of their patients and providing Pap smear. The same study found that patients cared for by HIV-trained NP or PA had significantly higher rate of influenza vaccination than patients under the care of non-HIV-expert generalists ($P = 0.02$).

3.4.5. Hospital Care and Costs

Only one study, [19] measured hospital-related care and costs and found no significant differences in all outcome measurements between HIV patients under the care of hospitalists and non-hospitalists (Table 1), including the rate of in-hospital mortality (rate = -1.7%, 95% CI -1.8 to -1.5, $P = 0.38$) and six-month mortality rate -1.6%, 95% CI -1.7 to -1.5, $P = 0.57$).

3.4.6. Psychosocial Outcome

Two studies [17] [19] measured patients' psychosocial outcomes such as quality of life and patient satisfaction.

Page *et al.*, [17] did not find any difference in patients' mean quality of life between patients who were cared

for by GP actively treating HIV patients, ID specialists and shared care after 12 months of care. Yet, compared to patients cared for by ID specialists, patients with GP ($P < 0.05$) and shared care ($P < 0.05$) had significantly higher patient satisfaction.

Schneider *et al.*, [19] observed no significant difference in 30-day self-reported health status (rate = -0.2% , 95% CI -0.2 to -0.2 , $P = 0.97$) and overall patients' self-rated satisfaction (-0.1% , 95% CI -0.1 to -0.7 , $P = 0.98$) between patients under the care of hospitalists and non-hospitalists.

3.4.7. Behavioural Outcome

Four studies [15] [17] [18] [22] assessed patients' ART adherence or outpatient visits.

3.5. ART Adherence

Horberg *et al.*, [15] found no significant difference in ART adherence in ART-naïve patients ($P = 0.97$) and ART-experienced patients ($P = 0.66$) under the care of non-ID/non-HIV-expert PCP, non-ID/HIV-expert PCP, ID specialists and HIV-trained NP or PA. In addition, Page *et al.*, [17] observed no significant difference in ART adherence between patients who received care from GP actively treating HIV patients, ID specialists or shared care.

3.6. Outpatient Visit

Landon *et al.*, [18] found that patients receiving care from ID physicians or HIV-expert generalists had significantly greater outpatient visits than patients under the care of non-HIV-expert generalists ($P < 0.01$). Additionally, Wilson *et al.*, [22] observed that outpatient visit rates among ID physicians, HIV-expert generalists and HIV-trained NP or PA were comparable. However, patients under HIV-trained NP or PA had significantly higher rate of outpatient visits than those under non-HIV-expert generalists ($P < 0.001$).

Non-HIV Related Outcomes and cART Interactions

None of the included studies reported any outcome related to medication errors, adverse drugs reactions and chronic diseases associated with long-term HIV care.

4. Discussion

While some studies included in this review have shown small differences in some outcomes, no conclusive evidence was identified about relative benefits and risks' regarding which specific type of healthcare provider was better at providing medical care to PLWHA. Yet, HIV patients who were cared for by HIV-expert healthcare providers (through accredited training or self-identification) and those who have HIV-related specialty (e.g. infectious disease) tend to achieve better virologic, immunologic and ART-related outcomes. When HIV patients were cared for by non-HIV-expert healthcare providers, the key to achieving successful outcomes was collaboration with HIV-expert clinicians or ID specialists. None of the included studies observed that healthcare providers with HIV expertise or HIV-related training performed poorer in the measured outcomes than clinicians without HIV-related expertise or specialty.

There is not enough evidence in this review to suggest that HIV care providers with greater caseloads—a proxy for experience—have better outcomes and improved patient survival [12]. For instance, Horberg *et al.*, [15] observed that healthcare providers' HIV experiences only influenced patients' virologic success in ART-naïve patients and did not affect ART adherence in both ART-naïve and ART-experienced patients. Additionally, Landon *et al.*, [18] found caseload to cause no effect on any of their eight quality-of-care measures. On the other hand, after adjusting for clinicians' training and HIV expertise, Landon *et al.*, [16] observed patients under the care of clinicians with lower HIV caseload had lower odds of being on cART 12 months after the approval of the first protease inhibitor and no significant effects 18 months after. These mixed results could be attributed to the complexities of ART regimen in which healthcare providers with more HIV-related experience were better informed than their less experienced colleagues. Yet, some of these findings, as observed in Landon *et al.*, [16] indicate that over time generalists are able to develop expertise specifically around ART that is comparable to that of specialists.

Findings from this review were observed to agree with a review by Rackal *et al.*, [13] which examined the ef-

fects of providers' training and experience on the quality of HIV care. In their review, they found that patients cared for by clinicians with HIV training or expertise had better medical and social outcomes than patients under clinicians without any HIV training or expertise. However, the authors were unable to find any association between the quality of care and providers' HIV experience.

Furthermore, evidence from this review shows that quality of care, adherence to treatment, [15] and use of cART, [16] [18] were not affected by the caseload or experience of the provider. This is in contrast to the findings by Handford *et al.*, [12] who found that HIV clinicians' with higher number of patients or greater experience with HIV patients had higher use of cART and decreased patients' mortality. This contrast could be attributed to different care settings and level of HIV experience considered in the reviews.

This systematic review has some important limitations. Only two of the included studies were published in the preceding five years and HIV care and treatment has evolved rapidly since then. No study reported on non-HIV related outcomes and cART interactions with other drugs even though these outcomes present major challenges particularly in older PLWHA with co-morbidities. Additionally, due to the small number of studies, their observational nature and the heterogeneity of the interventions and quality of care outcomes, a meta-analysis could not be performed. It is also important to note that in some of these studies, a small number of the outcome measurements were self-reported, mainly ART adherence and outpatient visits. In some studies, clinicians' HIV expertise was self-reported and was not confirmed by the study authors [16] [18] [22]. However, in this review we explicitly stated which outcomes or clinicians were self-reported. Furthermore, all but one of the included studies were conducted in the USA [17]. As HIV specialist training and health systems are different in many developed countries, including within the USA itself, evidence observed in this review needs to be interpreted with caution especially when applying such findings to other settings with different healthcare systems, training and social health coverage. In spite of these limitations, most of the studies had adequate controls for important confounding variables associated with patient and provider characteristics and most of the studies were of high quality.

5. Conclusions

In summary, this review provides some evidence for healthcare providers and policy makers to consider when providing medical care to PLWHA. Clinicians without HIV-related expertise or specialty were observed to perform poorer in some important dimensions of HIV care such as viral load control and use of cART.

Therefore, it is pertinent that clinicians who have limited HIV knowledge or expertise of caring for PLWHA should seek to gain more HIV knowledge and expertise or work in collaboration with HIV-trained clinicians and experts.

More high quality studies to assess the effectiveness of HIV care and treatment provided by different healthcare providers in developed countries are needed. Such studies should examine not only the virological or immunological outcomes of HIV care and treatment, but also other clinical outcomes relating to medication errors, knowledge of drug interactions and patient's quality of life.

Conflict of Interest

None declared.

Fund

None declared.

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Abbreviations and Acronyms

ART = antiretroviral therapy;

cART = combination antiretroviral treatment;

CI = confidence interval;

GP = general practitioner;

HIV = human immunodeficiency virus;

ID = infectious disease;

LMICS = low and middle-income countries;

NP = nurse practitioner;

OECD = Organisation for Economic Cooperation and Development;

PA = physician assistant;

PCP = primary care provider;

PJP = *Pneumocystic jiroveci* pneumonia;

PLWHA = people living with HIV/AIDS;

PPD = purified protein derivatives.