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Role of clinical pharmacists in reducing antimicrobial resistance: systematic review

Birbirsa Sefera (birraasafaraa2014@gmail.com)
Mettu University
Legesse Chelkeba
Addis Ababa University
Mesay Dechasa
Haramaya University

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Abstract

Background

Antimicrobial Resistance (AMR) is defined as the resistance of bacterial, viral, parasitic and fungal microorganisms to antimicrobial medicines that were previously effective for treatment of infectious disease. It is a major international concern in both developed and developing countries. Therefore, the aim of this review is to investigate the role of clinical pharmacists in reducing antimicrobial resistance.

Methods

The databases Medline, PubMed, International Pharmaceutical Abstracts (IPA), and EMBASE were searched for articles published between 1999 and 2019 that involved studies on the role of clinical pharmacists and the expanded services of clinical pharmacists in health care system and their contributions in antimicrobial use.

Results

Studies from different countries have demonstrated that the roles of clinical pharmacists in health care team resulting in improved clinical outcome and economic outcome.

Conclusions

This review highlights that integration of clinical pharmacist services in healthcare systems will assist in reducinggrowing of catastrophic AMR.

Introduction

Antimicrobial Resistance (AMR) is defined as the resistance of bacterial, viral, parasitic and fungal microorganisms to antimicrobial medicines that were previously effective for treatment of infectious disease. It occurs when bacteria, viruses and other microorganisms change in ways that cause existing medications (e.g. Antibiotics - bacterial infections, and antivirals - viral infections) to be ineffective [1]. Infections caused by antibiotic-resistant microorganisms are associated with high morbidity, mortality, and healthcare costs AMR annually causes 23,000 death in America 25,000 deaths in the European Union and 700 000 deaths in worldwide. By 2050, it is predicted that there will be 10 million deaths annually and US$100 trillion in global economic loss caused by drug-resistant bacterial infections if AMR continues to rise at the same pace as in the last decades. Overprescribing and inappropriate prescribing of antibiotics are the principal and the modifiable driver of AMR [2].

Antimicrobial resistance is a serious global health challenge that impacts all countries and all people, regardless of their wealth or status. It is predicted that by 2050 there will be more than ten million deaths per year attributed to AMR. Further, it is predicted that the greatest number of these deaths will be in developing countries. Therefore, there is an urgent need to take action to minimize the emergence of antimicrobial resistant bacteria in developing countries. The management of development and spread of AMR requires a multifaceted approach, including the participation of all healthcare workers. According to the first objective of the World Health Organization (WHO) global action plan on AMR, avoiding overuse and misuse of antibiotics requires healthcare professional’s awareness and understanding of AMR with effective communication, education and training. In this context, a clinical pharmacist is a key member of the antimicrobial multidisciplinary team involved in patients' pharmacotherapy monitoring. Pharmacists are important members of the healthcare team and they play a major role in medicine use and the provision of advice regarding appropriate medicines use. Education and training of pharmacists has the potential to influence the behavior of healthcare team members and consumers as part of a multidimensional strategy for changing practice and ensure the quality use of antibiotics [3].

Representative data on the extent of the problem in low-and middle-income countries are relatively scarce, but high levels of resistance are increasingly being reported worldwide. Antibiotic stewardship, that is, interventions designed to optimize use of antibiotics, is therefore one of the key actions of the World Health Organization (WHO) Global Action Plan to contain antibiotic resistance [4]. Although the role of multidisciplinary has been done in different countries to reduce AMR so far, there is no evidence that shows the role of clinical pharmacists alone in combating AMR. Therefore, the aim of this review is to investigate role of clinical pharmacists in reducing antimicrobial resistance in hospital and community setting.

Methods

Literature search strategy

A literature search was conducted to identify articles, published between 1999 and 2019 that involved studies on antimicrobial use or AMR involving clinical pharmacists in hospital and community settings using databases such as Medline, PubMed, International Pharmaceutical Abstracts (IPA), and EMBASE. The following ‘Medical Subject Headings’ (MeSH) terms were used to search articles: (Antimicrobial agents or antibiotics) OR (Drug Resistance, Bacterial or Antimicrobial resistance) AND (clinical pharmacy or Pharmacies) OR (Community Pharmacy Services) OR (Professional Role/ or Pharmacy Service, Hospital/ or Pharmacy/ or Pharmacists/ or Pharmacy practice.) OR (Clinical pharmacy) AND (Community pharmacist OR Clinical pharmacist OR Pharmaceutical care) AND (antimicrobial resistance or antibiotic cost).

Google Scholar was also used to search for articles with the appropriate keywords. The Following search words: Antibiotic stewardship, antimicrobial prescribing, Clinical pharmacy, Antibiotic consumption, Physician's perception, Clinical pharmacy; Antimicrobial utilization; Infectious disease; Pharmacist intervention, Antimicrobial stewardship, guideline adherence, pharmacist, urgent care, Antibiotic, Antimicrobials, Intravenous, Therapy-switch ,Pharmacist, Clinical pharmacy, Medication error, internal ward, Cost, pharmacists, outcomes, interventions, multidisciplinary, hospital, antibiotic optimization and antibiotic control programmers. The search words were used in different combinations. Cross-references of articles identified using these databases were also searched.

Inclusion and exclusion criteria

The inclusion criteria were as follows:

- Papers reporting descriptive accounts and papers reporting primary research involving an AMDT with pharmacy involvement.
- Full-text papers published in peer-reviewed journals.
- Full Papers published in English
- Papers involving interventions targeting hospital setting.

The Exclusion criteria are as follows

- Papers that was not available as full-text was discarded.
- Papers where there was either no multidisciplinary team or where the pharmacist had no role within the intervention were excluded.

Results

Author,Year [Reference]	Country	Setting	Objective	Study Design	Study Duration	Participants	Types of Intervention	Relevant Outcome	Outco Meas
N. Elkassas et al, 2018[5]	Egypt	General Hospital	To evaluate the acceptance of the role of the pharmacist in implementing antibiotic stewardship	Pre-post study	July,2014-Dec, 2015	Patients	CP involved in advising physicians about proper selection of antibiotics	Acceptance post intervention, (p < 0.001) DRPs is reduced, compliance to clinical pharmacist by physician increased	Defin dose 1000 days
Niaz Al-Somai.et al 2014 (6)	Saudi Arabia	Tertiary hospital	to measure the impact of the clinical pharmacist and infectious disease consultant interventions on the use of three antimicrobials (caspofungin, imipenem, meropenem)	pre and post study	August 31, 2011 to August 31, 2012	Patients	CP review medical chart, lab test and culture report, and provided therapeutic intervention, advice physician regarding doses, interaction and duration of antimicrobial	Significant reduction in the average duration of use (imipenem, p = 0.0144); and meropenem, p = 0.0089)	defin doses 100 b (DDD
Kiresten E. et al.2016 [7]	USA	Teaching hospital	To assess the impact of pharmacist intervention on appropriateness of antimicrobial prescribing on a geriatric psychiatric unit	Pre and post study	August 2014 - January 2015	Patients	CP reviewed patient chart and evaluated appropriateness of antimicrobial prescribing on geriatric psychiatric unit	Significantly less inappropriate doses for indication compared to the pre-intervention group (**10.6%** vs. **23.9%**, *p* = 0.02), and less antibiotics prescribed for an inappropriate duration (15.8% *vs.* 32.4%, *p* < 0.01), more patients in the post intervention group had medications prescribed with appropriate dose, duration, and indication (51% *vs.* 66%, *p* = 0.04)	Perce
N. Lauren, et al. 2019 [8]	USA	Hospital	To evaluate the impact of a pharmacist-led ASP in the urgent care setting	Pre-post study	2014–2016	Patients	Implementation of a pharmacist-led urgent care ASP	Antimicrobial prescribing for all patients including all diagnoses was significantly improved during the post-ASP period compared with the pre-ASP period (**53.3% and 41.3%**, respectively; *p* = 0.037)	pre- a ASP by pe
Hai-Xia Zhang. et al 2014 (9)	China	Tertiary hospital	To evaluate the impact and cost-benefit value of pharmacist interventions for Prophylactic antibiotic use	pre and post study	January 1, 2011 to June 30, 2012	Patients	CP intervened real-time monitoring of medical records and controlling of the prescriptions of prophylactic antibiotics against the criteria	Prolonged duration of prophylaxis decreased from 7.58 days to 2.91 days (p < 0.001). Mean antibiotic cost decrease from $338.59 to $98.95 (p, 0.001).] and significant increase was observed in the rate of correct choice of antibiotics (p < 0.001) after the intervention	Cost anala

Author,Year [Reference]	Country	Setting	Objective	Study Design	Study Duration	Participants	Types of Intervention	Relevant Outcome	Outco Meas
Lucas M. et al. 2012 [10]	Brazil	Hospital	To assess the impact of an intervention-prospective audit with feedback to prescriber, with and without the presence of a pharmacist in ASP team	Pre-post study	January 2003 to December 2008	Patients	follow all patient-cases prospectively, recording the clinical data associated with the antimicrobial agent and the patient illness	Consumption of antimicrobials decreased from 48.9% during pre-ASP to 36.9% in post-ASP (P = 0.001). The mean monthly antibiotic cost, during the pre-ASP was US$ 30,727.56, and US$ 9,623.73 in the last period of the study (P = 0.001)	mean consu DDD/ patie
Box MJ. et al 2015 (11)	California	Health care center	To assess impact of Pharmacists on ASP Teams in a Community Setting	Pre and post study	2011–2014	Patients	CP has a role in educational interventions and pharmacist led antimicrobial therapy duration of iv treatment	Improved the mean time to targeted antibiotic therapy (61.1 vs. 35.4 hrs; p = 0.001), reduced median time to positive culture from 3 days to 2 days (p = 0.0001), Adherence to the antibiotic treatment was 48.4% in the CG and 67.2% in the IG, p = 0.033)	Mean and p
Dunn K, et al. 201 1[12]	Ireland	university hospital	To assess the impact of the introduction of antimicrobial sub-committee-led, pharmacist delivered guidelines and criteria for switching from IV to PO antimicrobials	Pre-post study	December 2006 to June 2007	Patients	Application of stickers, guidelines to the drug chart, and providing consultation service to physician during IV to PO switch by PC	Significant reduction in the duration of IV antimicrobial treatment Improvement in the timeliness of IV to PO switch	Perce propo
Angoulvant F et al. 2013[13]	France	tertiary pediatric hospital,	To evaluate therapeutic education delivered in a pediatric emergency care and attitudes about judicious antibiotic use	randomized controlled trial	February 2, 2009 to September 26, 2011	Patients	Therapeutic education on antibiotic was delivered by CP in the pediatric emergency department	parents satisfied with the information on antibiotics received was significantly higher (96.9% versus 83%, *P* = 0.002)	perce paren satisf
Gross et al. 2001 [14]	USA	Tertiarycy Hospital	To improve the quality of patient care by ensuring the effectiveness of treatment regimens	Pre-post study	November 1993	Patients	Management of Antimicrobial recommendation	Better antimicrobial recommendations, cost effectiveness	Appro use, c failur first r

Author,Year [Reference]	Country	Setting	Objective	Study Design	Study Duration	Participants	Types of Intervention	Relevant Outcome	Outco Meas
H. Khalili et al. 2013 [15]	Iran	university Hospital	To evaluate the effect of clinical pharmacy services on medication costs	Pre and post study	September 2010 to September 2011	Patients	CP intervention involved with adding, discontinuation, and changing the frequency, duration or dose of drugs and Management of drug interactions, therapeutic drug level monitoring, stability of drugs and preventing medication error	Direct medication cost per patient was decreased ($160,140.5 ± 12,445.1 versus $141,621.8 ± 10,540.8), Hospitalization duration of patients reduced (15.8 ± 4.9 versus 17.3 ± 5.6 days, P < 0.001) and total number of ordered medication per patient was reduced by 9 ± 4.7 and 6.6 ± 3.1 (P < 0.001), CP recommendation on stability of drugs and preventing medication error was accepted 100% by nurses and physicians	Perce mear stanc devia
Gums et al, 1999 [16]	USA	Hospital	To identify financial and outcome benefits of therapeutic intervention by a multidisciplinary antimicrobial treatment team composed of Pharmacists, a clinical microbiologist, and an infectious disease specialist.	RCT	September 1994 to March 1996	Patients	Clinical pharmacist involved in recommendations concerning antibiotic therapy and monitoring, as necessary	Median length of stay was reduced from 9 to 5.7 days, (p = 0.0001) Median patient services' charges were reduced by $4404/intervention, (p = 0.008) and median hospital costs were reduced by $2642/intervention (p = 0.016)	Mear Mear

Conclusions

The provision of qualified clinical pharmacist services in healthcare systems has the potential to make a significant impact on reducing antimicrobial resistance. Studies from different countries have demonstrated that implementation of a pharmacist-led urgent care ASP, therapeutic advice, IV to PO conversion recommendation as per criteria, appropriate antimicrobial selection, reduction of hospital stay and consumption of antimicrobials, when they are recognized as part of the health care team. Antimicrobial stewardship involving pharmacists should be established in hospitals to ensure rational antimicrobial use. Therefore, integration of clinical pharmacist services in healthcare systems will assist in reducing growing of catastrophic AMR.

Strengths And Limitations

Strengths of this systematic review include the novelty of summarizing the role of clinical pharmacist in reducing antimicrobial resistance available in literature. A comprehensive search strategy of three large and reliable databases (Medline, PubMed, International Pharmaceutical Abstracts (IPA), and EMBASE) were used, meaning that it is likely that all relevant articles were identified. A limitation of this review is the inclusion of studies in English only which can cause information bias. While Medline, PubMed, International Pharmaceutical Abstracts (IPA), and EMBASE databases were searched, the absence of other databases such as Scopus could have introduced selection bias. While authors discussed the inclusion criteria and data being extracted, there is still the potential for confusion bias.

Abbreviations

CP: Clinical pharmacist; AMR: Antimicrobial resistance; WHO: World health organization; IPA: International Pharmaceutical Abstracts

Declarations

Authors' Contributions

BS conceived the idea, involved in the proposal development, data analysis, interpretation and manuscript writing. L.Ch was involved in the proposal development, data analysis, interpretation and manuscript writing. MD conceived the idea, developed the study proposal, facilitated data collection, did data analysis, and interpreted the findings.

Availability of data and materials

Data used and analyzed during the current study are available from corresponding author on reasonable request

Consent form for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Authors' details

1. Department of pharmacy, college of health sciences, Mettu University, mettu, Ethiopia

2. Department of pharmacology and clinical pharmacy, school of pharmacy, Institute of health sciences, Addis Ababa University, Addis Ababa, Ethiopia

3. Department of pharmacy, School of pharmacy, College of health and medical sciences, Haramaya University, Haramaya, Ethiopia

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