The burden of polypharmacy and potentially inappropriate medication in Nigeria: a clarion call for deprescribing practice

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Abstract

Background: Polypharmacy and potentially inappropriate medications (PIMs) could cause adverse drug events leading to poor health outcomes. This burden is addressed through deprescribing practice. However, data on deprescribing practices are lacking in Nigeria, where the healthcare systems are fragile.

Aim: This review aimed to summarise the literature on the burden of polypharmacy and PIMs and identify the need for deprescribing practice in Nigeria.

Method: A systematic search of the literature was conducted on MEDLINE through PubMed (Public Medline), Google Scholar, and a manual search of included articles to identify information on deprescribing, polypharmacy, and PIMs in Nigeria from the inception of the database to date. Relevant information from the articles was summarised and presented as subsections in the manuscript.

Results: In this review, we reported the burden of polypharmacy, PIMs, and the need for deprescribing practice in Nigeria. The estimated prevalence of polypharmacy was up to 23.8% among older patients with chronic disorders. Polypharmacy and PIMs have been reported to be a significant cause of medication non-adherence, drug addiction, drug interactions, adverse drug reactions, hospitalisation, morbidity, and mortality. Thus, there is the need to consider deprescription practice in the country.

Conclusion: This review revealed that polypharmacy and PIMs are common in Nigeria. Therefore, there is a need for deprescribing practice to improve drug safety in the country. This could be achieved through patient education, increasing awareness of deprescribing practice among the healthcare professionals, and ensuring adherence to the core prescribing indicators of the World Health Organization (WHO) and National Standard Treatment Guidelines.

Keywords: Polypharmacy, Deprescribing, Nigeria

Introduction

Polypharmacy is a global phenomenon with an increasing public health problem (Schenker et al. 2019). Polypharmacy refers to the use of multiple medications in a patient, usually a geriatric. While the most commonly used definition of polypharmacy is on five or more medications; the definitions are variable (Masnoon et al. 2017). Polypharmacy may be defined as the use of more medicines than are clinically necessary for a patient's comorbidities (Zarowitz et al. 2005). The rate of polypharmacy is increasing in developing countries like Nigeria due to the growing number of older adults (Tanyi et al. 2018). In Nigeria, the number of older individuals taking five or more prescription or over-the-counter medications varies from 25 to 35% (Akande-Sholabi et al. 2018a).

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Potentially inappropriate medications are medications for which the risks outweigh the benefits, especially in the presence of more effective alternatives (Renom-Guiteras et al. 2015). Polypharmacy and PIMs are associated with an increased risk of adverse drug reactions, hospitalisation, morbidity, and mortality (Reeve 2020).

Polypharmacy and PIMs could therefore benefit from an informed deprescribing process. Deprescribing is the practice of withdrawing an unnecessary medication to reduce polypharmacy and optimise outcomes monitored by a healthcare professional (Reeve 2020). The deprescribing process involves taking a history of drugs, identifying unnecessary medication, acknowledging the need to stop a medication, preparing and carrying out the medication's removal, and tracking outcomes during and after withdrawal (Reeve 2020).

There is emerging evidence that deprescribing is safe and helpful, but it can be challenging to incorporate deprescribing into clinical practice (Reeve 2020; Reeve et al. 2017). Several challenges to deprescribing have been identified from both the health practitioners' and patients' perspectives, including a shortage of resources to support deprescribing practice (Zechmann et al. 2019; Conklin et al. 2018). Thus, several tools have been created to help clinicians implement deprescribing practices (Reeve 2020). Despite the increasing prevalence of polypharmacy and PIM in Nigeria, there is limited application of controlled mechanisms like the deprescribing practice.

Nigeria is a developing country in West Africa with a reported poor healthcare system (Muanya and Onyenucheya 2021). The country has a population of about 200 million population, with a doctor to patient ratio of 1:5,000 (higher than the WHO recommendation of 1:600) (Muanya and Onyenucheya 2021). The country is battling with chaotic drug distribution systems, poor patients' compliance with medical authority, and healthcare workers to professionals' ethics (Boluwaduro 2021; Muhibi 2010). Therefore, in this review, we report the burden of polypharmacy and PIMs, and identified the need for deprescribing practice in Nigeria.

Main text
Literature selection method
A search strategy using the following terms both as medical subheading (MeSH) and free text as (all fields) was developed. The search terms used included: "polypharmacy"[MeSH Terms] OR "polypharmacy"[All Fields],"potentially inappropriate medication list"[MeSH Terms] OR "potentially inappropriate medication list"[All Fields] OR ("inappropriate prescribing "[MeSH Terms] OR" inappropriate prescribing"[All Fields] OR "inappropriate prescription"[All Fields])" deprescriptions "[MeSH Terms] OR "deprescriptions"[All Fields] OR

"deprescription"[All Fields]"Nigeria"[MeSH Terms] OR "nigeria"[All Fields] OR "nigeria s"[All Fields]. Relevant studies were also identified manually from the reference lists of the included articles. Additional information was also retrieved from Google Scholar using the following search expression "polypharmacy, potentially inappropriate medication, deprescribing in Nigeria." Based on previous recommendations, only the first 200 search results from the Google scholar search were considered for inclusion (Reeve et al. 2017). The search strategies employed in the systematic search of the literature in PubMed and Google Scholar are provided in "Appendix A".

Eligibility criteria
The studies included in this review were in peer-reviewed journals from the year 1980 to 2022, which were available in the English language. The chosen studies were those that focused on "polypharmacy, potentially inappropriate medication and deprescribing in Nigeria."

Results and discussions
The burden of polypharmacy and PIMs in Nigeria
In Nigeria, polypharmacy is common in clinical practice settings. Patients using between six and twelve medications have a higher risk of adverse drug events than patients with a lower quartile of drug use (Steinman et al. 2006). Akande and Ologe found that polypharmacy (particularly involving injectable formulations) and under-usage of life-saving drugs were common at a secondary healthcare facility in the North-central region of the country (Akande and Ologe 2007). The major risk factors for polypharmacy were reported as age, level of education, and diagnosis (Igbinomwanhia et al. 2017). The burden of polypharmacy had several clinical effects on the patients, ranging from medication non-compliance, addiction to drug interactions (Igbinomwanhia et al. 2017).

Antibiotics and antimalarials are often prescribed unnecessarily with little consideration for resistance and the development of adverse drug events (ADEs) (Nduka et al. 2017; Oshikoya et al. 2008). Antibiotics are among the most commonly misused medicines in Nigeria, and this poses a high risk of bacterial resistance, and adverse drug reactions, among other consequences (Akinyandenu and Akinyandenu 2014).

Fadare et al. (2018) used Beer's criteria to assess the prevalence of PIMs being prescribed to elderly Nigerian outpatients (65 years and above) in a rural south-west Nigerian hospital. They used a prospective cross-sectional study to assess drug-use indicators for 220 patients using WHO's guidelines, while the Beers criteria were employed to detect PIMs. Their findings

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showed that a total of 837 medicines were prescribed to the patients (i.e. 3.8 ± 1.3 drugs per patient), and 56 patients (i.e. 25.5% of total patients) were identified with at least one prescribed PIMs (Fadare et al. 2013). The identified PIMs were antihistamines, non-steroidal anti-inflammatory drugs (NSAIDs), and amitriptyline (Fadare et al. 2013). Similarly, the prevalence of PIMs prescribed to elderly patients in two tertiary health-care centres in South-Western Nigeria was estimated using Beers' and STOPP (Screening Tools of Older Person's Prescription) criteria. According to Beers' criteria assessment, the results showed that 30.3% of the 350 evaluated patients had at least one prescribed PIMs (Fadare et al. 2015a). Simultaneously, the STOPP criteria showed that 15.7% of the patients had at least one potential encounter with PIMs (Fadare et al. 2015a).

Saka et al. (2018) used 2015 updated Beers' criteria to evaluate PIMs, drug–drug interactions, and the inter-relation between these two issues with polypharmacy among Nigerian elderly patients (≥ 60 years) with chronic conditions. The study involved a retrospective evaluation of medicines prescribed to elderly patients, a total of 352, at Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State, Nigeria. The authors found that the PIMs and drug–drug interaction incidences were 35.2% and 5.7%, respectively, and the majority (54.5%) of the participants received polypharmacy. They also found that PIMs were significantly associated with drug–drug interactions and polypharmacy (Saka et al. 2018). In a similar investigation, Akande-Sholabi et al. (2018b) employed the Beers' 2015 criteria to determine the prevalence of PIMs and to describe their associated factors among 400 elderly patients with comorbidities that attended University College Hospital, Ibadan, Nigeria. They found that 81.5%, 17.7%, and 0.8% of the respondents were using one, two, and three PIMs, respectively, most of which happened to be NSAIDs (commonest) and benzodiazepines (Akande-Sholabi et al. 2018b).

To evaluate the extent of inappropriate antibiotics usage, a cross-sectional, retrospective evaluation of the drugs' prescribing pattern in public secondary and tertiary hospitals was recently conducted in Nasarawa State, Nigeria (Helma et al. 2020). A total of 2800 participants' records were accessed and evaluated during 10 years. The researchers used WHO's prescribing indicators and Strengthening Pharmaceutical System/United States Agency for International Development (SPS/USAID) to identify the irrational antibiotic usage. The results indicated a high deviation of most of the WHO or SPS/USAID prescribing indicators' optimal values, suggesting irrational antibiotic prescribing in Nasarawa State, Nigeria (Helma et al. 2020).

Saka et al. (2019) compared the prevalence of potentially inappropriate prescribing (PIP) and determined the associated factors among older patients at University teaching hospitals in Nigeria and South Africa. PIP among 680 participants was evaluated using the 2015 American Geriatrics Society-Beers Criteria. The PIP among participants from Nigeria and South Africa was found to be (124/352; 35.2%) and (97/328; 29.6%), respectively (Saka et al. 2019). The study further reported that hypertension was significantly associated with PIP. These findings suggest the need for considering deprescribing practice among the older population.

In another research, Akande-Sholabi et al. (2020) identified potentially inappropriate prescribing in ambulatory elderly patients and compared the appropriateness of guidelines; Beers' and screening tool of older person's prescription (STOPP)/screening tool to alert right treatment (START) criteria to detect potentially inappropriate prescribing among the elderly. The 2015 American Geriatrics Society (AGS)-Beers Criteria and version 2 of the STOPP and START were subsequently used to identify the PIP and potential prescribing omissions (PPOs). The study reported an average of 4.2 medications per patient prescription. The Beers criteria identified 26.5% PIP, while STOPP criteria identified 57.1% PIP. START detected 29 PPOs in 15 (4.4%) of the patient's prescriptions. Polypharmacy was significantly associated with PIP in both Beers and STOPP criteria (Akande-Sholabi et al. 2020). These studies demonstrate the extent of PIP and polypharmacy even when assessed using standard screening tools.

Overall, the literature suggests that poor compliance to core prescribing indicators of the World Health Organization (WHO) and the Nigerian Essential Drug List prescriptions/National Standard Treatment Guideline aggravated the PIMs problems in Nigeria (Chijoke-Nwauche et al. 2018). Therefore, there is a need for interventions to address these growing public healthcare problems in the country.

The rationale for deprescribing practice

Deprescribing is a purposeful and systematic activity carried out to control polypharmacy, remove PIMs, and enhance patient outcomes (Page et al. 2016, 2018a; Scott et al. 2015, 2017). The goal of producing a beneficial outcome distinguishes deprescribing from actions such as the omission of an indicated prescription by the prescriber or the patient's non-compliance with prescribed therapy (Page et al. 2018b). When more than one medicine is indicated for deprescribing, the rule of thumb is to discontinue each drug at an interval. These are withdrawn consecutively at monthly intervals to ensure that any change in clinical signs or symptoms can

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be attributed to just one medication (Page et al. 2018b). However, two or more medications can be removed concurrently in possible adverse drug reactions or a limited chance of an adverse drug withdrawal event (ADWE, for example, with supplements).

Polypharmacy stresses the need for medication review by the prescriber, thereby leading to deprescribing. In addition, multimorbidity also plays a vital role in justifying the practice of deprescribing. When there are many chronic disease conditions in patients, the number of drug–disease interactions increases, leading to drugs meant for a particular disease condition affecting a chronic disease condition (Schuling et al. 2012). Another important reason leading to medication discontinuation is when patients have multiple prescribers and visit numerous healthcare centres. These can lead to miscommunications about patients' medication between the prescribers, which give rise to the use of drugs that would have been discontinued or deprescribed to avert adverse events (Ailabouni et al. 2016). Optimising healthcare centres and prescribers could help minimise the rate of medication non-adherence (Reeve and Wiese 2014).

Discontinuation of medications should always prioritise older patients, given these patient populations have a high risk of polypharmacy, the transition of care, and multiple prescribers (Reeve et al. 2015). The high proportion of older patients in Nigeria could call the need for improving deprescribing practice in the country.

There is scanty information on Nigerian prescribers' awareness regarding appropriate prescribing and the screening tools for the elderly. This prompted some researchers to assess Nigerian physicians' knowledge about screening tools for PIMs for the elderly. The study revealed that although around 105 (85%) of the respondents indicated confidence in their ability to prescribe medications to elderly patients appropriately, only 20% and 15.6% of the respondents knew about Beer's and STOPP criteria, respectively (Fadare et al. 2019). This indicated a gross lack of knowledge among Nigerian physicians about screening tools for PIMs, and potentially implementing the deprescribing practice at healthcare facilities. This gap in knowledge and practice necessitates the call for deprescribing practice by physicians in Nigeria. Figure 1 illustrates an overview of deprescribing practice in Nigeria.

Implications of deprescribing practice in Nigeria
Minimising harms related to polypharmacy
Polypharmacy has been independently associated with drug-related hospital admission in Nigeria (Adedapo et al. 2020). Although deprescribing practice could reduce adverse events due to polypharmacy, a major challenge could be the influence (through incentives) of pharmaceutical sales representatives on doctors to prescribe multiple drugs to patients (Fadare et al. 2018). Therefore, improved awareness of the rationale of prescription and professional ethics are needed among doctors to ensure patient safety.

Improving medication non-adherence
A conceptual model has shown a relationship between polypharmacy and medication (non) adherence (Marcum and Gellad 2012). The literature suggests that medication non-adherence occurs in up to 55% of elderly patients receiving multiple medications (Zelko et al. 2016). In Nigeria, the prevalence among people with chronic illness ranges from 40.0 to 60.8% (Usman et al. 2019; Adisa et al. 2011; Chukwujekwu and Adesokun 2017). Even though it could be hypothesised that deprescribing could
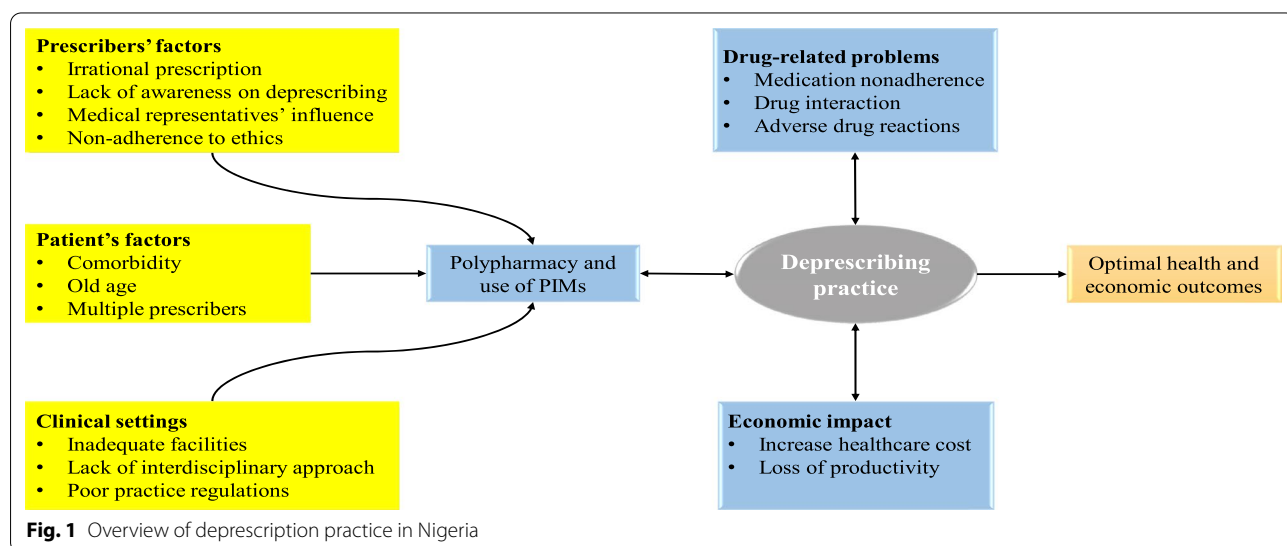

Fig. 1 Overview of deprescription practice in Nigeria

improve medication adherence, a systematic review of the literature showed that there is insufficient evidence to demonstrate that deprescribing practice improves medication adherence (Ulley et al. 2019). Therefore, while more evidence is needed, implementing deprescribing practices in Nigeria could improve medication adherence and subsequent optimal healthcare outcomes.

Reducing harm related to PIMs, falls, and ADR
Deprescribing has the potential to resolve adverse drug reactions (ADR), reducing adverse events such as drug interactions, incorrect indications, drug-related falls, and potentially inappropriate medications (PIMs). In Nigeria, the use of PIMs among older patients was up to 15.7–46.5% (Eze and Olowu 2011; Eze and Olowu 2011; Fadare et al. 2015b); the prevalence of falls and ADR among older people was 23% (Bekibele and Gureje 2010) and up to 10.7% (Aderemi-Williams et al. 2015), respectively. Also, ADR was associated with prolonged hospital stays (Fasipe et al. 2019). Thus, deprescribing practice in clinical settings could reduce these figures in Nigeria. Discontinuation of medications should always prioritise older patients, given these patient populations have a high risk of polypharmacy, the transition of care, and multiple prescribers (Reeve et al. 2015). The high proportion of older patients in Nigeria could call the need for improving deprescribing practice in the country. However, there is scanty information on Nigerian prescribers' awareness regarding appropriate prescribing and the screening tools for the elderly. The gap in knowledge and practice necessitates the call for deprescribing practice by physicians in Nigeria.

Economic benefits
Prescribing multiple drugs to inappropriate patients could contribute to unnecessary healthcare expenditure. In Nigeria, 70% of the population is poor (Kale 2012), and about 90% are not insured with over-reliance on out-of-pocket drug expenditure (Aregbeshola 2016). Discontinuing inappropriate medicines through deprescribing can reduce one-fifth of the total cost of drugs (Morin et al. 2019).

The legal implication of deprescribing in Nigeria
The legal implication of deprescribing has been discussed in the literature (Barnett and Kelly 2017a, b). In some cases, deprescribing can harm such as withdrawal syndrome from discontinuing antipsychotic medicines, disease relapse, or deterioration of a disease condition. Severe damage due to deprescription without patient consent could lead to legal litigation. In Nigeria, according to the Codes of medical ethics, it is "medical negligence" to change the treatment course of a disease without the consent of the patient (when such consent

is necessary) (Ende et al. 2017). Although the literature proposes a Model Reform Act on medical negligence litigation in Nigeria (Obafemi 2017), deprescribing without consent can potentially result in medical negligence litigation. This is possible because about 1.1% of all medical malpractice cases are reported to the court in Nigeria (Abugu and Obalum 2018).

In summary, the high rate of polypharmacy and PIM may be contributed by many factors such as those related to prescribers (irrational prescriptions, lack of awareness of the deprescribing practice, the influence of medical representatives, and non-adherence to practice ethics), patients (comorbidity, old age, and visiting multiple prescribers), and clinical settings (inadequate facilities, lack of interdisciplinary approach, and poor practice regulations). In the absence of deprescribing practice, these factors could lead to adverse events such as medication non-adherence, drug interactions, and ADRs. It will also increase healthcare costs and loss of productivity. Therefore, implementing deprescribing practices could minimise these burdens and improve optimal health and economic outcomes (Fig. 1).

Recommendations for deprescribing practice in Nigeria

1. There is a paucity of data related to deprescribing practice in Nigeria. Adequate knowledge about the problem could guide the development of targeted interventions. Thus, future research is needed to explore the rate of this practice among prescribers, healthcare settings, patient populations, drug classes, and different disease conditions.
2. Data from prospective cohort studies or controlled trials in Nigeria could assist in providing evidence for the health and economic impact of deprescribing practice on the patients and healthcare system in the country.
3. There is also the need for improved awareness and utilisation of the use of appropriate deprescribing tools such as Beer's Criteria and STOPP among prescribers for rational drug prescription at healthcare facilities. Also, developing screening tools that are most suitable for the Nigerian population and healthcare setting may create a good foundation for deprescribing practice research in Nigeria.
4. Provision of computerised decision support tools ("passive and active referential information as well as reminders, alerts, and guidelines" or "computer applications designed to aid clinicians in making diagnostic and therapeutic decisions in patient care") (Monteiro et al. 2019) could facilitate deprescribing practice in Nigeria.

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5. Continuing educational professional (CEP) courses of prescribers should be updated to include deprescribing practice. This will keep them abreast of the current trends and the urgent need to implement them appropriately. Also, incorporating courses specific to appropriate prescriptions in the curriculum of medical students could assist in providing a foundation of knowledge for future prescribers.

6. An interdisciplinary approach among health practitioners would assist in implementing deprescription practice in Nigeria. For example, a patient's medication review by competent pharmacists could detect polypharmacy and use of PIMs, which, when the prescriber is alert, can lead to deprescription and consequent optimal healthcare outcomes.

Conclusions

The burden of polypharmacy and the use of PIMs are common in Nigeria. The literature demonstrates that deprescribing practice could address healthcare and the economic burden related to polypharmacy and the use of PIMs. Therefore, there is a need for interventions to improve awareness and educate the prescribers about the need to implement deprescribing practices at healthcare facilities in the country. The intervention measures should include more research to identify the problems for targeted solutions.

Appendix A
PubMed Search Strategies

#1	11,430	"Polypharmacy"[MeSH Terms] OR "polypharmacy"[All Fields]
#2	8460	"Potentially inappropriate medication list"[MeSH Terms] OR ("potentially"[All Fields] AND "inappropriate"[All Fields] AND "medication"[All Fields] AND "list"[All Fields]) OR "potentially inappropriate medication list"[All Fields] OR ("inappropriate prescribing"[MeSH Terms] OR ("inappropriate"[All Fields] AND "prescribing"[All Fields]) OR "inappropriate prescribing"[All Fields] OR ("inappropriate"[All Fields] AND "prescription"[All Fields]) OR "inappropriate prescription"[All Fields])
#3	793	"Deprescriptions"[MeSH Terms] OR "deprescriptions"[All Fields] OR "deprescription"[All Fields]
#4	60,429	"Nigeria"[MeSH Terms] OR "nigeria"[All Fields] OR "nigeria s"[All Fields]
#1 + #2 + #3 + #4	105	("Potentially inappropriate medication list"[MeSH Terms] OR ("potentially"[All Fields] AND "inappropriate"[All Fields] AND "medication"[All Fields] AND "list"[All Fields]) OR "potentially inappropriate medication list"[All Fields] OR ("inappropriate prescribing"[MeSH Terms] OR ("inappropriate"[All Fields] AND "prescribing"[All Fields]) OR "inappropriate prescribing"[All Fields] OR ("inappropriate"[All Fields] AND "prescription"[All Fields]) OR "inappropriate prescription"[All Fields]) OR ("polypharmacy"[MeSH Terms] OR "polypharmacy"[All Fields]) OR ("deprescriptions"[MeSH Terms] OR "deprescriptions"[All Fields] OR "deprescription"[All Fields])) AND ("nigeria"[MeSH Terms] OR "nigeria"[All Fields] OR "nigeria s"[All Fields])

Proposed Scopus database Search Strategies

#1	Polypharmacy OR Polymedication
#2	"PIM List" OR "PIM Lists" OR "Potentially Inappropriate Medications" OR "Inappropriate Medication, Potentially" OR "Inappropriate Medications, Potentially" OR "Medication, Potentially Inappropriate" OR "Medications, Potentially Inappropriate" OR "Potentially Inappropriate Medication" OR "Beers Criteria" OR "Beers Potentially Inappropriate Medications" OR "de Beers Criteria" OR "Beers Criteria, de" OR "STOPP (Screening Tool of Older Person's Potentially Inappropriate Prescriptions)" OR "STOPPs (Screening Tool of Older Person's Potentially Inappropriate Prescriptions)" OR "Screening Tool of Older Person's Potentially Inappropriate Prescriptions" OR "STOPP" OR "STOPP START Criteria" OR "Criteria, STOPP START" OR "Criterias, STOPP START" OR "START Criteria, STOPP" OR "START Criterias, STOPP" OR "STOPP START Criterias" OR "Medication Appropriateness Index" OR "Appropriateness Index, Medication" OR "Appropriateness Indices, Medication" OR "Index, Medication Appropriateness" OR "Indices, Medication Appropriateness" OR "Medication Appropriateness Indices" OR "Inappropriate Prescrib*" OR "Inappropriate Prescript*" OR "Over Prescrib*" OR "Over Prescrip*"
#3	Deprescribing OR Deprescription OR Deprescrib* OR Deprescrip*
#1 + #2 + #3	

Proposed Google Scholar Search Strategies

#1	72	Polypharmacy potentially inappropriate medication deprescribing in Nigeria

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Availability of data and materials
Not applicable.

Declarations

Ethical approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declared no competing interests.

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References
Abugu U, Obalum DC (2018) An agenda for improving legal claims for medical malpractice in Nigeria. Asian Soc Sci 14(5):118

Adedapo ADA, Adedeji WA, Adedapo IA, Adedapo KS (2020) Cohort study on adverse drug reactions in adults admitted to the medical wards of a tertiary hospital in Nigeria: prevalence, incidence, risk factors, and fatality. Br J Clin Pharmacol 87:1878–1889

Aderemi-Williams RI, Awodele O, Boyle CA (2015) Adverse drug reactions amongst adult patients admitted in Lagos State University Teaching Hospital Lagos, Nigeria. Curr Drug Saf 10(2):136–144

Adisa R, Fakeye TO, Fasanmade A (2011) Medication adherence among ambulatory patients with type 2 diabetes in a tertiary healthcare setting in southwestern Nigeria. Pharm Pract (granada) 9(2):72

Ailabouni NJ, Nishtala PS, Mangin D, Tordoff JM (2016) Challenges and enablers of deprescribing: a general practitioner perspective. PLoS ONE 11(4):e0151066

Akande T, Ologe M (2007) Prescription pattern at a secondary health care facility in Ilorin, Nigeria. Ann Afr Med 6(4):186–189

Akande-Sholabi W, Adebusoye LA, Olowookere OO (2018a) Polypharmacy and factors associated with their prevalence among older patients attending a geriatric centre in South-West Nigeria. West Afr J Pharm 29(1):35–45

Akande-Sholabi W, Adebusoye LA, Olowookere OO (2018b) Potentially inappropriate medication use among older patients attending a geriatric centre in south-west Nigeria. Pharm Pract (granada) 16(3):1235

Akande-Sholabi W, Ajilore OC, Showande SJ, Adebusoye LA (2020) Potential inappropriate prescribing among ambulatory elderly patients in a geriatric centre in southwestern Nigeria: beers criteria versus STOPP/START criteria. Trop J Pharm Res 19(5):1105–1111

Akinyandenu O, Akinyandenu A (2014) Irrational use and non-prescription sale of antibiotics in Nigeria, a need for change. J Sci Innov Res 3(2):251–257

Aregbeshola BS (2016) Out-of-pocket payments in Nigeria. The Lancet 387(10037):2506

Barnett N, Kelly O (2017a) Deprescribing: is the law on your side? Eur J Hosp Pharm 24(1):21–25

Barnett N, Kelly Ó (2017b) Legal implications of deprescribing: a case scenario. Prescriber 28(3):49–52

Bekibele CO, Gureje O (2010) Fall incidence in a population of elderly persons in Nigeria. Gerontology 56(3):278–283

Boluwaduro E (2021) Patients' compliance and resistance to medical authority in Nigerian clinical encounters. J Pragmat 171:8–19

Chijoke-Nwauche IN, Chukwumezie CA, Udezi TW (2018) Prescribing indicators: a review in the general outpatient clinic of a Nigerian Tertiary Hospital

Chukwujekwu CD, Adesokun OK (2017) Prevalence of medication non-adherence among psychiatric patients in a tertiary hospital in Nigeria. J Biosci Med 5(04):1

Conklin J, Farrell B, Suleman S (2018) Implementing deprescribing guidelines into frontline practice: barriers and facilitators. Res Soc Adm Pharm 15:796–800

Eze UI, Olowu AO (2011) Prescribing patterns and inappropriate use of medications in elderly outpatients in a tertiary hospital in Nigeria. Trop J Pharm Res 10(1):27–31

Fadare JO, Agboola SM, Opeke OA, Alabi RA (2013) Prescription pattern and prevalence of potentially inappropriate medications among elderly patients in a Nigerian rural tertiary hospital. Ther Clin Risk Manag 9:115

Fadare JO, Desalu OO, Obimakinde AM, Adeoti AO, Agboola SM, Aina FO (2015a) Prevalence of inappropriate medication prescription in the elderly in Nigeria: a comparison of Beers and STOPP criteria. Int J Risk Saf Med 27(4):177–189

Fadare JO, Desalu OO, Obimakinde AM, Adeoti AO, Agboola SM, Aina FO (2015b) Prevalence of inappropriate medication prescription in the elderly in Nigeria: a comparison of Beers and STOPP criteria. Int J Risk Saf Med 27(4):177–189

Fadare JO, Oshikoya KA, Ogunleye OO, Desalu OO, Ferrario A, Enwere OO, Adeoti A, Sunmonu TA, Massele A, Baker A (2018) Drug promotional activities in Nigeria: impact on the prescribing patterns and practices of medical practitioners and the implications. Hosp Pract 46(2):77–87

Fadare JO, Obimakinde AM, Enwere OO, Desalu OO, Ibidapo RO (2019) Physician's knowledge of appropriate prescribing for the elderly—a survey among family and internal medicine physicians in Nigeria. Front Pharmacol 10:592

Fasipe OJ, Akhideno PE, Owhin OS (2019) The observed effect of adverse drug reactions on the length of hospital stay among medical inpatients in a Nigerian University Teaching Hospital. Toxicol Res Appl 3:2397847319850451

Helma RA, Ngwai YB, Nkene IH, Adamu S (2020) Assessment of rational antibiotic prescribing in public hospitals in Nasarawa State, Nigeria. Eur J Biol Biotechnol 1(4)

Igbinomwanhia NG, Olotu SO, James BO (2017) Prevalence and correlates of antipsychotic polypharmacy among outpatients with schizophrenia attending a tertiary psychiatric facility in Nigeria. Ther Adv Psychopharmacol 7(1):3–10

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Kale Y (2012) The Nigeria poverty profile 2010 report. A paper presentation at the National bureau of statistics press briefing on Nigeria Poverty Profile 2010 report

Marcum ZA, Gellad WF (2012) Medication adherence to multidrug regimens. Clin Geriatr Med 28(2):287–300

Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE (2017) What is polypharmacy? A systematic review of definitions. BMC Geriatr 17(1):1–10

Monteiro L, Maricoto T, Solha I, Ribeiro-Vaz I, Martins C, Monteiro-Soares M (2019) Reducing potentially inappropriate prescriptions for older patients using computerized decision support tools: systematic review. J Med Internet Res 21(11):e15385

Morin L, Todd A, Barclay S, Wastesson JW, Fastbom J, Johnell K (2019) Preventive drugs in the last year of life of older adults with cancer: is there room for deprescribing? Cancer 125(13):2309–2317

Muanya C, Onyenucheya A (2021) Bridging doctor-patient ratio gap to boost access to healthcare delivery in Nigeria. In: The Guardian

Muhibi M (2010) Adherence to professional ethics among medical laboratory personnel: a prerequisite for quality health care delivery in Nigeria. Western Niger J Med 3

Nduka SO, Edebeatu C, Isidienu CP, Amorha KC (2017) Prescribing practices for pediatric out-patients: a case study of two teaching hospitals in Nigeria. Trop J Pharm Res 16(3):705–711

Obafemi KAR (2017) Medical negligence litigation in Nigeria: identifying the challenges and proposing a model law reform act. Trinity College Dublin, Dublin

Oshikoya K, Bello J, Ayorinde E (2008) Prescribing knowledge and skills of final year medical students in Nigeria. Indian J Pharmacol 40(6):251

Page AT, Clifford RM, Potter K, Schwartz D, Etherton-Beer CD (2016) The feasibility and effect of deprescribing in older adults on mortality and health: a systematic review and meta-analysis. Br J Clin Pharmacol 82(3):583–623

Page AT, Clifford RM, Potter K, Etherton-Beer CD (2018a) A concept analysis of deprescribing medications in older people. J Pharm Pract Res 48(2):132–148

Page A, Clifford R, Potter K, Etherton-Beer C (2018b) A concept analysis of deprescribing medications in older people. J Pharm Pract Res 48(2):132–148

Reeve E (2020) Deprescribing tools: a review of the types of tools available to aid deprescribing in clinical practice. J Pharm Pract Res 50(1):98–107

Reeve E, Wiese MD (2014) Benefits of deprescribing on patients' adherence to medications. Int J Clin Pharm 36(1):26–29

Reeve E, Simon BJ, Hilmer SN (2015) Barriers to optimising prescribing and deprescribing in older adults with dementia: a narrative review. Curr Clin Pharmacol 10(3):168–177

Reeve E, Thompson W, Farrell B (2017) Deprescribing: a narrative review of the evidence and practical recommendations for recognizing opportunities and taking action. Eur J Intern Med 38:3–11

Renom-Guiteras A, Meyer G, Thürmann PA (2015) The EU(7)-PIM list: a list of potentially inappropriate medications for older people consented by experts from seven European countries. Eur J Clin Pharmacol 71(7):861–875

Saka SA, Oosthuizen F, Nlooto M (2018) An evaluation of potential inappropriate prescribing among older persons in Nigeria. Glob J Health Sci 10(11):1–28

Saka SA, Oosthuizen F, Nlooto M (2019) Potential inappropriate prescribing and associated factors among older persons in Nigeria and South Africa. Int J Clin Pharm 41(1):207–214

Schenker Y, Park SY, Jeong K, Pruskowski J, Kavalieratos D, Resick J, Abernethy A, Kutner JS (2019) Associations between polypharmacy, symptom burden, and quality of life in patients with advanced, life-limiting illness. J Gen Intern Med 34(4):559–566

Schuling J, Gebben H, Veehof LJG, Haaijer-Ruskamp FM (2012) Deprescribing medication in very elderly patients with multimorbidity: the view of Dutch GPs. A qualitative study. BMC Fam Pract 13(1):1–7

Scott IA, Hilmer SN, Reeve E, Potter K, Le Couteur D, Rigby D, Gnjidic D, Del Mar CB, Roughead EE, Page A (2015) Reducing inappropriate polypharmacy: the process of deprescribing. JAMA Intern Med 175(5):827–834

Scott IA, Anderson K, Freeman C (2017) Review of structured guides for deprescribing. Eur J Hosp Pharm 24(1):51–57

Steinman MA, Seth LC, Rosenthal GE, Berthenthal D, Sen S, Kaboli PJ (2006) Polypharmacy and prescribing quality in older people. J Am Geriatr Soc 54(10):1516–1523

Tanyi PL, André P, Mbah P (2018) Care of the elderly in Nigeria: implications for policy. Cogent Soc Sci 4(1):1555201

Ulley J, Harrop D, Ali A, Alton S, Davis SF (2019) Deprescribing interventions and their impact on medication adherence in community-dwelling older adults with polypharmacy: a systematic review. BMC Geriatr 19(1):15

Usman MN, Umar MD, Idris FA, Abdullahi Y (2019) Medication adherence and its associated factors among hypertensive patients in a tertiary health facility in Minna, North central Nigeria. Arch Clin Hypertens 5(1):003–007

van der Ende MY, Hartman MHT, Hagemeijer Y, Meems LMG, de Vries HS, Stolk RP, de Boer RA, Sijtsma A, van der Meer P, Rienstra M, van der Harst P (2017) The LifeLines cohort study: prevalence and treatment of cardiovascular disease and risk factors. Int J Cardiol 228:495–500

Zarowitz BJ, Stebelsky LA, Muma RTM, Peterson EL (2005) Reduction of high-risk polypharmacy drug combinations in patients in a managed care setting. Pharmacotherapy 25(11):1636–1645

Zechmann S, Trueb C, Valeri F, Streit S, Senn O, Neuner-Jehle S (2019) Barriers and enablers for deprescribing among older, multimorbid patients with polypharmacy: an explorative study from Switzerland. BMC Fam Pract 20(1):1–10

Zelko E, Klemenc-Ketis Z, Tusek-Bunc K (2016) Medication adherence in elderly with polypharmacy living at home: a systematic review of existing studies. Mater Socio-Med 28(2):129–132

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