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Overuse of medications

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Overuse of medications in low- and middle-income countries: a scoping review

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Abstract

Objective To identify and summarize the evidence about the extent of overuse of medications in low- and middle-income countries, its drivers, consequences and potential solutions.

Methods We conducted a scoping review by searching the databases PubMed®, Embase®, APA PsycINFO® and Global Index Medicus using a combination of MeSH terms and free text words around overuse of medications and overtreatment. We included studies in any language published before 25 October 2021 and were reporting on the extent of overuse, its drivers, consequences and solutions.

Findings We screened 3489 unique records and included 367 studies reporting on over 5.1 million prescriptions across 80 low- and middle-income countries – with studies from 58.6% (17/29) of all low-, 62.0 % (31/50) of all lower-middle and 60.0% (33/55) upper-middle-income countries. Of the included studies, 307 (83.7%) reported on the extent of overuse of medications, with estimates ranging from 7.3% to 98.2% (interquartile range: 30.2–64.5). Commonly overused classes included antimicrobials,

psychotropic drugs, proton pump inhibitors and antihypertensive drugs. Drivers included limited knowledge of harms of overuse, polypharmacy, poor regulation and financial influences. Consequences were patients harm and cost. Only 11.4% (42/367) of studies evaluated solutions, which included regulatory reforms, educational, deprescribing and audit–feedback initiatives.

Conclusion Growing evidence suggests overuse of medications is widespread within low- and middle-income countries, across multiple drug classes, with few data of solutions from randomized trials. Opportunities exist to build collaborations to rigorously develop and evaluate potential solutions to reduce overuse of medications.

Introduction

Overuse in health care is broadly defined as tests or treatments that are inappropriate, unnecessary or of low-value and are likely to cause people more harm than benefit. Hence, health-care overuse is a recognized threat to both human health and health system sustainability.^{1,2}

Estimates of global overuse suggest that 20–40% of health-care resources may be wasted and that these resources might be better invested tackling unmet need, including underuse.^{3–5} While much of the evidence for overuse arises from high-income countries, where there is greater access to care, the consequences due to overuse may be even more serious in low-resource settings.¹ For example, medication overuse, a key component of health-care overuse, can threaten both the viability of public budgets, including the universal health coverage, and population health in low- and middle-income countries.¹

Global initiatives such as Choosing Wisely⁶ and Preventing Overdiagnosis⁷ are increasingly interested in addressing the problem of overuse in low- and middle-income settings. To identifying gaps in the evidence-base and developing an agenda for future research and actions, we conducted a scoping review to characterize the evidence about the extent of overuse of medications in these countries, its drivers, consequences and potential solutions to reduce it in low- and middle-income countries. The work has also contributed to building a new global network to take the new agenda forward.

Methods

We conducted this scoping review following the Joanna Briggs Institute guidance,⁸ using an accelerated approach,⁹ and reported it following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews.¹⁰ The protocol was prospectively developed and registered at Open Science Framework.¹¹

Search strategy

We searched four electronic databases: PubMed®, Embase®, APA PsycINFO® and Global Index Medicus, from inception until 25 October 2021, using a low- and middle-country search filter from Cochrane¹² and without language restrictions. We used a combination of MeSH terms and free text words for the following general concepts: overuse of medications/overtreatment (Box 1; available at: <http://www.who.int/bulletin/volumes/98/###/##-#####>). We searched reference lists of all included studies; and contacted experts in the field to identify relevant and important grey literature.

Eligibility criteria

We included studies from one or more low- and middle-income countries¹³ with a major focus on any of the four medication overuse themes: (i) extent of overuse; (ii) drivers and factors related to overuse; (iii) consequences of overuse; and (iv) solutions addressing the overuses. We included studies reporting data on low- and middle-income countries and high-income countries if data pertaining to low- and middle-income countries could be analysed separately or the majority ($\geq 75\%$) of reported data were from low- and middle-income countries. For this review, we used a broad commonly used definition of overuse of medications as the provision of medications which are unlikely to benefit the patient given the harms, cost, available alternatives or preferences of the patient – including unnecessary, inappropriate and potentially inappropriate medications.^{1,2} We also accepted operational definitions and assessments of primary study authors to estimate the extent of overuse of medications – including using Beers criteria® for Potentially Inappropriate Medication Use in Older Adults, or the screening tool of older person's prescriptions (STOPP), or appropriateness as judged by local guidelines.

We used the World Bank categorization from 2021¹³ to define low- and middle-income countries (available in data repository).¹⁴

We included quantitative interventional and observational studies as well as qualitative studies, both primary and secondary studies, such as systematic reviews of eligible primary studies, and peer-reviewed articles or grey literature (e.g. eligible reports from governmental and nongovernmental organizations and conference abstracts). We included studies regardless of clinical setting (inpatient or outpatient, or the level of care), type of medications assessed (e.g. whether prescribed or nonprescription medications) and population type. We excluded case reports and case series, non-research opinion or analysis, literature reviews, conference abstracts

with limited information to judge eligibility or to use for evidence synthesis, and studies where overuse of medications was not a major or primary focus or finding of the study.

Study selection

A total of nine pairs of reviewers independently screened titles and abstracts, and subsequently full text, using an open-access web-based tool.⁹ Any disagreements were resolved, at all stages, by discussion or reference to a third author.

Data extraction

We used a prospectively developed and piloted data extraction form. A single reviewer extracted data on (i) study characteristics including sample size and study design; (ii) overuse of medications including conditions and medication studied; (iii) main study themes (extent, drivers, consequences, and solutions); and (iv) relevant key findings. For secondary studies (e.g. systematic reviews), we extracted data from summarized information of included studies and not directly from primary studies.

Data synthesis

We grouped studies by a priori defined groups: (i) the major focus or the four main themes; (ii) condition (i.e. per Global burden of Disease classification); (iii) countries or country income level; and (iv) medication classes (i.e. by the major categories in the United States Pharmacopeial Medicare Model Guidelines v6.0).

Results

We identified a total of 3489 unique records. After screening titles and abstracts, we identified 711 records for full-text screening. Of the full-text articles screened, 338 were excluded with reasons recorded, and we included 373 articles^{15–387} reporting on a total of 367 unique studies (Fig. 1).^{15–381}

Characteristics of studies

The 367 included studies collectively reported on 5 120 468 prescribed or nonprescription medications (median: 1185; interquartile range, IQR: 333–3017) and more than 5 322 693 million participants (median: 495; IQR: 222–1522) from 80 low- and middle-income countries. Of all 134 low- and middle-income countries, we found studies from 17 (58.6%) of all 29 low-income countries, 31 (62.0%) of all 50 low middle-income, and 33 (60.0%) of all 55 upper middle-

income countries. Twenty-one studies were multinational. Of the 346 studies originating from single countries, 232 (67.1%) were from upper-middle income countries and 99 (28.6%) from East-Asia and the Pacific region (Table 1; Fig. 2).

Most studies (330; 89.9%) were published after 2010, with a marked increase in the number of studies per year. Most studies were written in English (347; 94.6%). In 195 studies (53.1%), the health-care setting was hospital-based. The study design in 313 (85.3%) studies was observational and in 26 (7.1%) studies was qualitative only. Twelve studies (3.3%) declared any funding from industry sources (Table 1; data repository).¹⁴

Extent of overuse

Of the included studies, 307 (83.7%; Table 2) reported on the extent of overuse of medications. Overall, the estimates of overuse of medications ranged from 7.3% in a study of 1264 older adults with diabetes in Turkey (i.e. overtreated with blood pressure lowering and anti-diabetic medications)³²⁰ to 98.2% in a study of 599 critically ill older patients (i.e. ≥ 1 potentially inappropriate medications).¹⁴¹ The IQR of the estimates reported in 307 studies was 30.2–64.5% (Box 2; Fig. 3).

The top five classes of medications that were most frequently examined and reported in the 307 studies were (i) antimicrobials (110 studies; 35.8%); (ii) antianxiety, antidepressants and antipsychotics (89 studies; 30.0%); (iii) antihypertensive drugs (74 studies; 24.1%); (iv) analgesics and steroids (67 studies; 21.8%); and (v) proton pump inhibitors and antacids (48 studies; 15.6%; Table 2).

The three most common methods for assessing overuse of medications were: comparing existing prescribing practices with what would be considered appropriate under local professional norms or guidelines (114 studies; 37.1%); using Beers criteria® to identify potentially inappropriate medications (80 studies; 26.1%); and using STOPP (32 studies; 10.4%; Table 2).

Antimicrobials

The estimate of the overuse of antibiotics in the 110 studies range from 18.4% (40/217 prescriptions) in a retrospective evaluation of the inappropriateness of antibiotic prescribed for 735 patients in 3 primary health care clinics in Malaysia³⁰⁹ to 97.0% (194) of 200 pharmacies inappropriately dispensing antibiotics without prescriptions in Syrian Arab Republic.³⁶ A 2019 Chinese survey of more than 74 648 antibiotics prescriptions in 16 rural primary care, found that

only 8.8% (6567) of prescriptions were appropriate and 84.1% (62 780) of prescriptions were deemed unnecessary, according to guidelines.⁹⁶ A 2021 systematic review of 23 studies estimated the proportion of nonprescription inappropriate dispensing of antibiotics in Sub-Saharan African countries at 69.0 % (95% confidence interval, CI: 58.0–80.0).⁷³ The IQR of the estimates reported in the 110 studies was 34.3–66.5%. In the 14 low-income countries included, the estimates ranged between 53.9% and 85.4%; the ranges were 30.5–64.3% and 34.3–60.9% for 28 lower-middle- and 61 upper-middle-income countries, respectively (Table 2).

Psychotropic drugs

The estimates of the overuse of antianxiety and antidepressant medications in the 89 studies range from 10.0 % in a survey of 1048 Chilean adults 65 years or older according to Beers criteria²⁶⁹ to 91.0 % in a cross-sectional analysis of 456 older adults in a tertiary hospital in India using both Beers and STOPP criteria.³¹¹ The IQR of the estimates reported in the 89 studies was 30.1–61.7%. There was no study for a low-income country. For 10 lower-middle- and 77 upper-middle-income countries, the estimate range were 28.6–87.3% and 31.2–61.4%, respectively (Table 2).

Analgesics, proton pump inhibitors and antihypertensive drugs

A cross-sectional analysis of medical records of 13 274 elderly patients in four community hospitals in Thailand found that 79.0% (10486) of patients were prescribed one or more potentially inappropriate medications, using the Lists of Risk Drugs for Thai Elderly criteria. Antihypertensive drugs, proton pump inhibitors and analgesics being the most frequently prescribed potentially inappropriate medications.²⁷⁴ Another cross-sectional analysis of medical records of 6337 older adults in China found 79.4% (5033) prescribed one or more potentially inappropriate medications according to either Beers criteria® or STOPP, with antihypertensive, antianxiety and non-steroidal anti-inflammatory drugs among the most common potentially inappropriate medications.²⁰¹

Drivers

Drivers and factors related to the overuse of medications in low- and middle-income countries were reported in 139 (37.9%) studies, with 74 studies reporting on individual-level (i.e. clinician or patient e.g. knowledge and skills or preferences) and 40 on system-level drivers or factors (i.e. institutional or organization, e.g. resource allocation, staffing and national guidelines; Table 3). Only 10 of these studies were from low-income countries,^{20,77,111,127,129,144,166,183,262,337} and we did

not observe clear associations between country income-levels and drivers (Box 2), nor could we observe any geographic variations in the drivers.

Individual-level drivers

Of the studies reporting on individual-level drivers, 24 studies cited limited knowledge among clinicians or patients on the harms of overuse, 12 studies pointed to perceived or actual patients' demands, while polypharmacy and/or multimorbidity was found as a factor in 38 studies, largely studies of potentially inappropriate medications among the elderly people (Table 3). For example, a study of 6400 hospitalized older patients in China, found that 64.8% (4147) of prescriptions were inappropriate based on Beers criteria®, with proton pump inhibitors most commonly potentially inappropriate medication, and polypharmacy was the most important factor associated with potentially inappropriate medications.¹⁶² In a qualitative study with clinicians and older adults in Burkina Faso, a low-income country, drivers of overuse included poor patient-clinician communication, limited clinicians knowledge, and incentives from pharmaceutical companies, with one doctor noting “there is this surge of medical representatives who crisscross the hospitals.”¹⁶³

System-level drivers

Of the studies reporting on system-level drivers and factors, 11 studies cited regulatory issues such as poorly enforced regulations or policies; 16 studies cited constrained resources, including limited access to diagnostic facilities, and problematic access in rural or regional places; and 13 studies cited financial factors such as profitability of health-care providers and industry influence (Table 3). For example, a nationwide Malaysian study of 5810 antibiotic prescriptions in 545 clinics (129 public and 416 private clinics), found much higher proportions of antibiotic prescriptions (30.8%; 5055/16415 vs 6.8%; 755/11172), and antibiotic prescriptions for respiratory tract infections (16.7%; 49/293 vs 57.7%; 1479/2564) in private clinics versus public, most of which was considered unnecessary.¹⁵

Consequences

Consequences of overuse of medications were reported in 31 studies (8.4%), including just one from a low-income country (Table 3).²¹ The two most commonly identified consequences of overuse were harms – such as adverse drug reactions, impacts on quality of life or mortality – and costs. For example, a study among 125 heart-failure patients in Lebanon found a moderate correlation between potentially inappropriate medications and reduced quality of life,³⁷⁴ while

another small study of 127 older adults in Brazil found no impact of potentially inappropriate medications on mortality, during a 10-year follow-up.¹¹¹ In relation to costs, a study in Islamic Republic of Iran estimated that almost 1 million United States dollars (US\$) was wasted within a year in one teaching hospital on unnecessary antibiotics, measured as use not adherent to local guidelines.²⁹² In 2020, a survey in Lebanon found widespread overuse of proton pump inhibitors and estimated that the nation may be wasting US\$ 25 million annually as a result.¹⁷⁰ No studies in low-income countries assessed costs of overuse.

Potential solutions

Evaluations of potential solutions were reported in 42 studies (11.4%), with 23 studies reporting on interventional rather than observational studies (Table 3). Only 4 studies of solutions were based in low-income countries^{231,249,329,335} (data repository).¹⁴

Twenty-three studies of solutions focused on antibiotics (Table 3). For example, a review identified multiple interventions successfully reduced inappropriate antibiotics in low- and middle-income countries, including national action plans, educational campaigns, urged wider use of audit–feedback initiatives and regulatory or legal changes to reduce self-purchasing of antibiotics.¹⁴⁵ Similarly, a large study of long-term antibiotic use in 55 low- and middle-income countries, using World Health Organization databases, found that having national policies and/or strategies on rational antibiotic use is associated with an estimated 20% reductions in antibiotic use for upper respiratory tract infections and an estimated 30% reduction in antibiotics use for acute diarrheal illness.¹⁶⁷

For non-antibiotic overuse, 19 studies evaluated potential solutions, including educational interventions, deprescribing initiatives, new technologies and interventions involving pharmacists (Table 3). In Uganda, a low-income country, two cluster RCTs of 127 villages and 381 community health workers found dramatic reductions in the overuse of anti-malarial drugs following the introduction of rapid diagnostic tests (48.5% absolute reduction: from 79.3%; 520/656; to 30.8%; 215/699).^{247,388} In Argentina, a multifaceted intervention including educational workshops, deprescribing algorithms and automated email-alerts was found to successfully reduce inappropriate medications among 900 older adults (overall absolute reduction of 8.5% across eight classes of potentially inappropriate medications – relative reduction of 73% for non-steroidal anti-inflammatory drugs and 31% for benzodiazepines).³⁰³ Also in Argentina, an email-linked behavioural intervention underpinned by social-norm feedback reduced

inappropriate prescriptions and cost for cognitively impaired older adults. Physicians in the intervention group made fewer inappropriate prescriptions than physicians in control group, mean 93.25 prescriptions (95% CI: 89.27–97.24) versus 98.99 (95% CI: 95.00–102.98).³⁴¹ In Thailand, a large study of 11 915 patients across four community hospitals found that computerized decision support systems that detect potentially inappropriate medications was associated with 13.3 percentage points decrease (from 87.7% to 74.4%) in potentially inappropriate medications.²⁷⁵

A 2021 Chinese study found that an intervention by clinical pharmacists halved the rate of inappropriate prescriptions of proton pump inhibitors (from 48.9 to 22.7 prescriptions per 100 patient-day), with no harmful impacts.³⁷⁸ Encouragingly, a 2018 survey in Ethiopia, a low-income country, assessing attitudes to deprescribing, found that 81.6% (258/316) of people asked were willing to stop one or more medications if possible and if agreed by their doctors.³³⁵

Discussion

We found widespread evidence of high proportions of overuse of medications in low- and middle-income countries. Classes of commonly overused medications included antibiotics, benzodiazepines, non-steroidal anti-inflammatory drugs, proton pump inhibitors and antihypertensive medicines. Drivers of overuse included a lack of knowledge of overuse among patients or clinicians, insufficient resources to access optimum care, polypharmacy, financial factors including the profit-motive, and weak or poorly enforced regulations. Consequences were harms from adverse drug reactions and high costs of inappropriate use of scarce resources. While only a small number of studies evaluated potential solutions, we identified feasible and effective interventions, even for the lowest income settings, to tackle the problem of overuse.

Almost 90% of the included studies were published in the past 10 years, emphasizing the growing interest in understanding and addressing overuse of medications in low- and middle-income countries. We observed wide dispersions of the proportion of overuse of medications; this finding might be attributed to the differences in the population, settings, medications and methods used among included studies. Only a few studies evaluated the consequences, such as financial wasting. Wasting of resources is catastrophic for health care systems in low- and middle-income countries – that already fragmented and fragile.³⁸⁹ Future research should not only estimate the extent of overuse of prescribed medications, but also estimate the extent and drivers of the overuse from nonprescription medications. Furthermore, studies should evaluate the potential physical, psychological and social consequences,

both at individual and health-care system levels. Further research should also include improving the methods to evaluate the harms and consequences associated with overuse of medications.

The finding that only a tenth of studies evaluated potential solutions points to a gap in the literature and the need to intensify research evaluating innovative solutions to reduce overuse, while at the same time improving the rigor of the science assessing the extent and nature of the problem. Our review finds evidence from low- and middle-income countries of significant reductions in inappropriate medications, using for example multifaceted interventions or deprescribing initiatives, which suggests such interventions are practical as well as desirable. However, future studies replicating successful interventions from high-income countries need to include more robust evaluations of individual-level (e.g. educational interventions, audit and feedback, and clinical decision support system) and system-level solutions (e.g. changes in payment and incentives and changes in regulations and policies).³⁹⁰

We also found strong evidence of very high levels of overprescription of antibiotics across many low- and middle-income countries. Such overprescription is associated with antibiotic resistance,³⁹¹ however, there are hopeful signs those overprescription rates can be reduced with national policies and local initiatives.^{145,167} Research evaluating potential solutions for unnecessary prescription needs to focus on nonprescription antibiotic dispensing in drug shops and antibiotic prescriptions by private health-care providers. This research might include multicomponent interventions combining educational programmes to improve public awareness; engagement of pharmacists in patient education and consumer guideline development; audit and feedback; and more incisive regulations and policies to reduce inappropriate antibiotics use in low- and middle-income countries.³⁹²

Our finding that only 7% of studies were from low-income countries suggests that either the problem of overuse may not be so pressing in places where underuse is a clear priority for stakeholders, or that the problem of overuse is understudied.

Our review has limitations. To achieve the breadth required of a scoping review, we have necessarily included studies used a range of definitions and methods, from assessing adherence to guidelines for appropriate use, to the potentially inappropriate medications assessments using the Beers criteria®, STOPP and other criteria. While we broadly accepted the definitions used by authors of the studies, if our review team could find no evidence in the study of an explicit method to measure overuse, the study was excluded. Generally, definitions of inappropriate use equate to use when a medication is not clinically indicated, or the overuse of a medication which may bring more harm than benefit, but in some studies, use of the term inappropriate also included finer details relating to dosage,

frequency or duration of use. A further limitation arises from our subjective categorization of system- versus individual-level drivers, where there may be clear overlap among these drivers. Another minor limitation arises from applying the World Bank income level list from 2021 to studies conducted over many previous years, however, the income level has not changed for most low- and middle-income countries.¹³

The findings of this review suggest the time has arrived to build a global community of researchers, clinicians, policy-makers and citizens who will share, build and improve the science of overuse in low- and middle-income countries. The global community should have a focus on scaling up effective solutions to reduce harm and save wasted resources. Initiatives to tackle overuse of medications in low- and middle-income countries are currently limited and of a particular focus – such as the Global Antimicrobial Resistance Partnership.^{393–395} This review’s broad findings confirm the need for global discussions to prioritize research and action agendas. Global initiatives which have largely arisen in high-income countries to tackle overuse, such as Right Care, Preventing Overdiagnosis and Choosing Wisely, will only be strengthened through developing links with, and learning from, colleagues in low- and middle-income countries.

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Competing interests:

RM has helped organize Preventing Overdiagnosis conferences. All other authors declare no competing interests.

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Box 1. Search strategy used to identify studies on overuse of medications in low- and middle-income countries

Search on 21 October 2021

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("Medical Overuse"[Mesh] OR Overmedicalization[tiab] OR Overmedicalisation[tiab] OR Overtreatment[tiab] OR "Over-treatment"[tiab] OR ((Overuse[tiab] OR Unnecessary[ti] OR Unwarranted[tiab] OR Inappropriate[ti] OR Deprescribing[tiab] OR De-implementation[tiab] OR Deimplementation[tiab]) AND (Medication[tiab] OR Therapeutic[tiab] OR Therapeutics[tiab] OR Antibiotics[tiab] OR Medicine[ti] OR Medicines[tiab] OR Prescriptions[tiab] OR "Pharmacological treatment"[tiab] OR "Pharmacological treatments"[tiab]))))

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AND

(afghanistan OR albania OR algeria OR "american samoa" OR angola OR antigua OR barbuda OR argentina OR armenia OR armenian OR aruba OR azerbaijan OR bahrain OR bangladesh OR barbados OR belarus OR byelarus OR belorussia OR byelorussian OR belize OR "british honduras" OR benin OR dahomey OR bhutan OR bolivia OR bosnia OR herzegovina OR botswana OR bechuanaland OR brazil OR brasil OR bulgaria OR "burkina faso" OR "burkina fasso" OR "upper volta" OR burundi OR urundi OR "cabo verde" OR "cape verde" OR cambodia OR kampuchea OR "khmer republic" OR cameroon OR cameron OR cameroun OR "central african republic" OR "ubangi shari" OR chad OR chile OR china OR colombia OR comoros OR "comoro islands" OR mayotte OR congo OR zaire OR "costa rica" OR "cote divoire" OR "cote d ivoire" OR "cote divoire" OR "cote d ivoire" OR "ivory coast" OR croatia OR cuba OR cyprus OR "czech republic" OR czechoslovakia OR djibouti OR "french somaliland" OR dominica OR "dominican republic" OR ecuador OR egypt OR "united arab republic" OR "el salvador" OR "equatorial guinea" OR "spanish guinea" OR eritrea OR estonia OR eswatini OR swaziland OR ethiopia OR fiji OR gabon OR "gabonese republic" OR gambia OR georgia OR georgian OR ghana OR "gold coast" OR gibraltar OR greece OR grenada OR guam OR guatemala OR guinea OR guyana OR guiana OR haiti OR hispaniola OR honduras OR hungary OR india OR indonesia OR timor OR iran OR iraq OR "isle of man" OR jamaica OR jordan OR kazakhstan OR kazakh OR kenya OR korea OR kosovo OR kyrgyzstan OR kirghizia OR kirgizstan OR "kyrgyz republic" OR kirghiz OR laos OR "lao pdr" OR "lao peoples democratic republic" OR latvia OR lebanon OR lesotho OR basutoland OR liberia OR libya OR "libyan arab jamahiriya" OR lithuania OR macau OR macao OR macedonia OR madagascar OR "malagasy republic" OR malawi OR nyasaland OR malaysia OR maldives OR "indian ocean" OR mali OR malta OR micronesia OR kiribati OR "marshall islands" OR nauru OR "northern mariana islands" OR palau OR tuvalu OR mauritania OR mauritius OR mexico OR moldova OR moldovian OR mongolia OR montenegro OR morocco OR ifni OR mozambique OR "portuguese east africa" OR myanmar OR burma OR namibia OR nepal OR "netherlands antilles" OR nicaragua OR niger OR nigeria OR oman OR muscat OR pakistan OR panama OR "papua new guinea" OR paraguay OR peru OR philippines OR philipines OR phillipines OR philippines OR poland OR "polish peoples republic" OR portugal OR "portuguese republic" OR "puerto rico" OR romania OR russia OR "russian federation" OR ussr OR "soviet union" OR "union of soviet socialist republics" OR rwanda OR ruanda OR samoa OR "pacific islands" OR polynesia OR "samoan islands" OR "sao tome" AND principe OR "saudi arabia" OR senegal OR serbia OR seychelles OR "sierra leone" OR slovakia OR "slovak republic" OR slovenia OR melanesia OR "solomon island" OR "solomon islands" OR "norfolk island" OR somalia OR "south africa" OR "south sudan" OR "sri lanka" OR ceylon OR "saint kitts" AND nevis OR "st kitts" AND nevis OR "saint lucia" OR "st lucia" OR "saint vincent" OR "st vincent" OR grenadines OR sudan OR suriname OR surinam OR Syrian Arab Republic OR "syrian arab republic" OR tajikistan OR tadjikistan OR tadzhikistan OR tadzhik OR tanzania OR tanganyika OR thailand OR siam OR "timor leste" OR "east timor" OR togo OR "togolese republic" OR tonga OR trinidad OR tobago OR tunisia OR turkey OR turkmenistan OR turkmen OR uganda OR ukraine OR uruguay OR uzbekistan OR uzbek OR vanuatu OR "new hebrides" OR venezuela OR vietnam OR "viet nam" OR "middle east" OR "west bank" OR gaza OR palestine OR yemen OR yugoslavia OR zambia OR zimbabwe OR "northern rhodesia" OR "global south" OR "africa south of the sahara" OR "sub saharan africa" OR "subsaharan africa" OR "central africa" OR "north africa" OR "northern africa" OR magreb OR maghrib OR sahara OR "southern africa" OR "east africa" OR "eastern africa" OR "west africa" OR "western africa" OR "west indies" OR "indian ocean islands" OR caribbean OR "central america" OR "latin america" OR "south america" OR "central asia" OR "north asia" OR "northern asia" OR "southeastern asia" OR "south eastern asia" OR "southeast asia" OR "south east asia" OR "western asia" OR "east europe" OR "eastern europe" OR "developing country" OR "developing countries" OR "developing nation" OR "developing nations" OR "developing population" OR "developing populations" OR "developing world" OR "less developed country" OR "less developed countries" OR "less developed nation" OR "less developed nations" OR "less developed world" OR "lesser developed countries" OR "lesser developed nations" OR "under developed country" OR "under developed countries" OR "under developed nations" OR "under developed world" OR "underdeveloped country" OR "underdeveloped countries" OR "underdeveloped nation" OR "underdeveloped nations" OR "underdeveloped population" OR "underdeveloped populations" OR

“underdeveloped world” OR “middle income country” OR “middle income countries” OR “middle income nation” OR “middle income nations” OR “middle income population” OR “middle income populations” OR “low income country” OR “low income countries” OR “low income nation” OR “low income nations” OR “low income population” OR “low income populations” OR “lower income country” OR “lower income countries” OR “lower income nations” OR “lower income population” OR “lower income populations” OR “underserved countries” OR “underserved nations” OR “underserved population” OR “underserved populations” OR “under served population” OR “under served populations” OR “deprived countries” OR “deprived population” OR “deprived populations” OR “poor country” OR “poor countries” OR “poor nation” OR “poor nations” OR “poor population” OR “poor populations” OR “poor world” OR “poorer countries” OR “poorer nations” OR “poorer population” OR “poorer populations” OR “developing economy” OR “developing economies” OR “less developed economy” OR “less developed economies” OR “underdeveloped economies” OR “middle income economy” OR “middle income economies” OR “low income economy” OR “low income economies” OR “lower income economies” OR “low gdp” OR “low gnp” OR “low gross domestic” OR “low gross national” OR “lower gdp” OR “lower gross domestic” OR Imic OR Imics OR “third world” OR “lami country” OR “lami countries” OR “transitional country” OR “transitional countries” OR “emerging economies” OR “emerging nation” OR “emerging nations”)

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(Medical Overuse.ti,ab. OR Overmedicalization.ti,ab. OR Overmedicalisation.ti,ab. OR Overtreatment.ti,ab. OR Over-treatment.ti,ab. OR ((Overuse.ti,ab. OR Unnecessary.ti. OR Unwarranted.ti,ab. OR Inappropriate.ti. OR Deprescribing.ti,ab. OR De-implementation.ti,ab. OR Deimplementation.ti,ab.) AND (Medication.ti,ab. OR Therapeutic.ti,ab. OR Therapeutics.ti,ab. OR Antibiotics.ti,ab. OR Medicine.ti. OR Medicines.ti,ab. OR Prescriptions.ti,ab. OR “Pharmacological treatment.”ti,ab. OR “Pharmacological treatments.”ti,ab.)))

AND

(afghanistan.mp. OR albania.mp. OR algeria.mp. OR “american samoa.”mp. OR angola.mp. OR antigua.mp. OR barbuda.mp. OR argentina.mp. OR armenia.mp. OR armenian.mp. OR aruba.mp. OR azerbaijan.mp. OR bahrain.mp. OR bangladesh.mp. OR barbados.mp. OR belarus.mp. OR byelarus.mp. OR belorussia.mp. OR byelorussian.mp. OR belize.mp. OR “british honduras.”mp. OR benin.mp. OR dahomey.mp. OR bhutan.mp. OR bolivia.mp. OR bosnia.mp. OR herzegovina.mp. OR botswana.mp. OR bechuanaland.mp. OR brazil.mp. OR brasil.mp. OR bulgaria.mp. OR “burkina faso.”mp. OR “burkina fasso.”mp. OR “upper volta.”mp. OR burundi.mp. OR urundi.mp. OR “cabo verde.”mp. OR “cape verde.”mp. OR cambodia.mp. OR kampuchea.mp. OR “khmer republic.”mp. OR cameroon.mp. OR cameron.mp. OR cameroun.mp. OR “central african republic.”mp. OR “ubangi shari.”mp. OR chad.mp. OR chile.mp. OR china.mp. OR colombia.mp. OR comoros.mp. OR “comoro islands.”mp. OR mayotte.mp. OR congo.mp. OR zaire.mp. OR “costa rica.”mp. OR “cote d’ivoire.”mp. OR “cote d’ivoire.”mp. OR “cote divoire.”mp. OR “cote d ivoire.”mp. OR “ivory coast.”mp. OR croatia.mp. OR cuba.mp. OR cyprus.mp. OR “czech republic.”mp. OR czechoslovakia.mp. OR djibouti.mp. OR “french somaliland.”mp. OR dominica.mp. OR “dominican republic.”mp. OR ecuador.mp. OR egypt.mp. OR “united arab republic.”mp. OR “el salvador.”mp. OR “equatorial guinea.”mp. OR “spanish guinea.”mp. OR eritrea.mp. OR estonia.mp. OR eswatini.mp. OR swaziland.mp. OR ethiopia.mp. OR fiji.mp. OR gabon.mp. OR “gabonese republic.”mp. OR gambia.mp. OR georgia.mp. OR georgian.mp. OR ghana.mp. OR “gold coast.”mp. OR gibraltar.mp. OR greece.mp. OR grenada.mp. OR guam.mp. OR guatemala.mp. OR guinea.mp. OR guyana.mp. OR guiana.mp. OR haiti.mp. OR hispaniola.mp. OR honduras.mp. OR hungary.mp. OR india.mp. OR indonesia.mp. OR timor.mp. OR iran.mp. OR iraq.mp. OR “isle of man.”mp. OR jamaica.mp. OR jordan.mp. OR kazakhstan.mp. OR kazakh.mp. OR kenya.mp. OR korea.mp. OR kosovo.mp. OR kyrgyzstan.mp. OR kirghizia.mp. OR kirgizstan.mp. OR “kyrgyz republic.”mp. OR kirghiz.mp. OR laos.mp. OR “lao pdr.”mp. OR “lao people’s democratic republic.”mp. OR latvia.mp. OR lebanon.mp. OR lesotho.mp. OR basutoland.mp. OR liberia.mp. OR libya.mp. OR “libyan arab jamahiriya.”mp. OR lithuania.mp. OR macau.mp. OR macao.mp. OR macedonia.mp. OR madagascar.mp. OR “malagasy republic.”mp. OR malawi.mp. OR nyasaland.mp. OR malaysia.mp. OR maldives.mp. OR “indian ocean.”mp. OR mali.mp. OR malta.mp. OR micronesia.mp. OR kiribati.mp. OR “marshall islands.”mp. OR nauru.mp. OR “northern mariana islands.”mp. OR palau.mp. OR tuvalu.mp. OR mauritania.mp. OR mauritius.mp. OR mexico.mp. OR moldova.mp. OR moldovian.mp. OR mongolia.mp. OR montenegro.mp. OR morocco.mp. OR ifni.mp. OR mozambique.mp. OR “portuguese east africa.”mp. OR myanmar.mp. OR burma.mp. OR namibia.mp. OR nepal.mp. OR “netherlands antilles.”mp. OR nicaragua.mp. OR niger.mp. OR nigeria.mp. OR oman.mp. OR muscat.mp. OR pakistan.mp. OR panama.mp. OR “papua new guinea.”mp. OR paraguay.mp. OR peru.mp. OR philippines.mp. OR philipines.mp. OR phillipines.mp. OR phillippines.mp. OR poland.mp. OR “polish people’s republic.”mp. OR portugal.mp. OR “portuguese republic.”mp. OR “puerto rico.”mp. OR romania.mp. OR russia.mp. OR “russian federation.”mp. OR ussr.mp. OR “soviet union.”mp. OR “union of soviet socialist republics.”mp. OR rwanda.mp. OR ruanda.mp. OR samoa.mp.

OR "pacific islands."mp. OR polynesia.mp. OR "samoan islands."mp. OR "sao tome" AND principe.mp. OR "saudi arabia."mp. OR senegal.mp. OR serbia.mp. OR seychelles.mp. OR "sierra leone."mp. OR slovakia.mp. OR "slovak republic."mp. OR slovenia.mp. OR melanesia.mp. OR "solomon island."mp. OR "solomon islands."mp. OR "norfolk island."mp. OR somalia.mp. OR "south africa."mp. OR "south sudan."mp. OR "sri lanka."mp. OR ceylon.mp. OR "saint kitts" AND nevis.mp. OR "st kitts" AND nevis.mp. OR "saint lucia."mp. OR "st lucia."mp. OR "saint vincent."mp. OR "st vincent."mp. OR grenadines.mp. OR sudan.mp. OR suriname.mp. OR surinam.mp. OR Syrian Arab Republic.mp. OR "syrian arab republic."mp. OR tajikistan.mp. OR tadjikistan.mp. OR tadjikistan.mp. OR tadjik.mp. OR tanzania.mp. OR tanganyika.mp. OR thailand.mp. OR siam.mp. OR "timor leste."mp. OR "east timor."mp. OR togo.mp. OR "togolese republic."mp. OR tonga.mp. OR trinidad.mp. OR tobago.mp. OR tunisia.mp. OR turkey.mp. OR turkmenistan.mp. OR turkmen.mp. OR uganda.mp. OR ukraine.mp. OR uruguay.mp. OR uzbekistan.mp. OR uzbek.mp. OR vanuatu.mp. OR "new hebrides."mp. OR venezuela.mp. OR vietnam.mp. OR "viet nam."mp. OR "middle east."mp. OR "west bank."mp. OR gaza.mp. OR palestine.mp. OR yemen.mp. OR yugoslavia.mp. OR zambia.mp. OR zimbabwe.mp. OR "northern rhodesia."mp. OR "global south."mp. OR "africa south of the sahara."mp. OR "sub saharan africa."mp. OR "subsaharan africa."mp. OR "central africa."mp. OR "north africa."mp. OR "northern africa."mp. OR magreb.mp. OR maghrib.mp. OR sahara.mp. OR "southern africa."mp. OR "east africa."mp. OR "eastern africa."mp. OR "west africa."mp. OR "western africa."mp. OR "west indies."mp. OR "indian ocean islands."mp. OR caribbean.mp. OR "central america."mp. OR "latin america."mp. OR "south america."mp. OR "central asia."mp. OR "north asia."mp. OR "northern asia."mp. OR "southeastern asia."mp. OR "south eastern asia."mp. OR "southeast asia."mp. OR "south east asia."mp. OR "western asia."mp. OR "east europe."mp. OR "eastern europe."mp. OR "developing country."mp. OR "developing countries."mp. OR "developing nation."mp. OR "developing nations."mp. OR "developing population."mp. OR "developing populations."mp. OR "developing world."mp. OR "less developed country."mp. OR "less developed countries."mp. OR "less developed nation."mp. OR "less developed nations."mp. OR "less developed world."mp. OR "lesser developed countries."mp. OR "lesser developed nations."mp. OR "under developed country."mp. OR "under developed countries."mp. OR "under developed nations."mp. OR "under developed world."mp. OR "underdeveloped country."mp. OR "underdeveloped countries."mp. OR "underdeveloped nation."mp. OR "underdeveloped nations."mp. OR "underdeveloped population."mp. OR "underdeveloped populations."mp. OR "underdeveloped world."mp. OR "middle income country."mp. OR "middle income countries."mp. OR "middle income nation."mp. OR "middle income nations."mp. OR "middle income population."mp. OR "middle income populations."mp. OR "low income country."mp. OR "low income countries."mp. OR "low income nation."mp. OR "low income nations."mp. OR "low income population."mp. OR "low income populations."mp. OR "lower income country."mp. OR "lower income countries."mp. OR "lower income nations."mp. OR "lower income population."mp. OR "lower income populations."mp. OR "underserved countries."mp. OR "underserved nations."mp. OR "underserved population."mp. OR "underserved populations."mp. OR "under served population."mp. OR "under served populations."mp. OR "deprived countries."mp. OR "deprived population."mp. OR "deprived populations."mp. OR "poor country."mp. OR "poor countries."mp. OR "poor nation."mp. OR "poor nations."mp. OR "poor population."mp. OR "poor populations."mp. OR "poor world."mp. OR "poorer countries."mp. OR "poorer nations."mp. OR "poorer population."mp. OR "poorer population."mp. OR "poorer populations."mp. OR "developing economy."mp. OR "developing economies."mp. OR "less developed economy."mp. OR "less developed economies."mp. OR "underdeveloped economies."mp. OR "middle income economy."mp. OR "middle income economies."mp. OR "low income economy."mp. OR "low income economies."mp. OR "lower income economies."mp. OR "low gdp."mp. OR "low gnp."mp. OR "low gross domestic."mp. OR "low gross national."mp. OR "lower gdp."mp. OR "lower gross domestic."mp. OR lmic.mp. OR lmic.s.mp. OR "third world."mp. OR "lami country."mp. OR "lami countries."mp. OR "transitional country."mp. OR "transitional countries."mp. OR "emerging economies."mp. OR "emerging nation."mp. OR "emerging nations."mp.)

Global Index Medicus (WPRIM (Western Pacific); LILACS (Americas); IMSEAR (South-East Asia); IMEMR (Eastern Mediterranean); AIM (Africa))

("Medical Overuse" OR Overmedicalization OR Overmedicalisation OR (ti:(Overtreatment OR Over-treatment OR Overuse OR Deprescribing OR De-implementation OR Deimplementation)) AND (tw:(Medication OR Therapeutic OR Therapeutics OR Antibiotics OR Medicine OR Medicines OR Prescriptions OR "Pharmacological treatment" OR "Pharmacological treatments"))))

Box 2. Examples of key findings in the scoping review on overuse of medications in low- and middle-income countries

Estimation of overuse (307 studies; Table 2)

For low-income countries (21 studies), the IQR of overuse estimates was 48.2–82.5%.

A cross sectional study evaluating the appropriateness of antibiotic use for acute diarrheal disease among 303 patients hospitalized in a large Ethiopian hospital serving 1.2 million people, showed that 86.8% (263) of patients have received at least one antibiotic drug (92.6%; 174/188 of children younger than five years).³⁴³ the rate of overuse of antibiotics was 72.3%,³⁴³ which is a high level of overuse of antibiotics according to the recommendations of WHO for treating diarrheal disease.

For lower middle-income countries (63 studies), the IQR of overuse estimates was 26.8–66.2%.

A retrospective analysis evaluating the use of potentially inappropriate medicines in 676 elderly patients in an Indian teaching hospital showed that 590 (87.3%) patients received at least one inappropriate medicine according to Beers criteria®, – with Metoclopramide was the most commonly used inappropriate medications (54.3%; 367 patients).¹⁷⁹

For upper middle-income countries (205 studies), the IQR of overuse estimates was 29.0–62.5.

A cross sectional study evaluating the prevalence of potentially inappropriate medications among geriatric inpatients in a 3 000-bed teaching hospital in China showed that the proportion of potentially inappropriate medications was 64.8% (4163/6424) according to Beers 2019 criteria® and 64.3% (4131/6424) according to Beers 2015 criteria®, proton-pump inhibitors was the most commonly prescribed inappropriate medication.¹⁶²

Drivers of overuse(139 studies; Table 3)

A qualitative study explored the drivers of antibiotics overuse in *Médecins Sans Frontières* projects located in four low-income African countries. Study included 384 people who participated in semi-structured in-depth interviews; focus group discussions; and field observations. System-level drivers included failing health-care systems, such as underdeveloped and understaffed primary and secondary health-care systems. Individual-level drivers include strong patient demands for antibiotics that influenced prescription decisions and high proportions of self-medication.³⁸³

Researchers of a qualitative study to identify drivers of potentially inappropriate medication use, interviewed 417 geriatric patients in 22 public primary care facilities in Brazil, an upper middle-income country. Important patient-related drivers included short consultation times (< 10 minutes) and polypharmacy. Clinicians-related drivers included the number of patients attended and number of prescriptions per clinician.⁴³

Consequences of overuse (31 studies; Table 3)

A cross-sectional study examined the costs and appropriateness of prophylactic preoperative antibiotic use among 1 000 consecutive patients in six teaching hospitals in Islamic Republic of Iran, an upper middle-income country. Antibiotics were prescribed for 85 out of 87 (97.7%) procedures in which an antibiotic was not indicated. The average cost of antibiotic prescription per surgical procedure was US\$ 100 and the estimated total cost of inappropriate prescription of cefazoline alone (most frequently prescribed antibiotic) was US\$ 4623, the GDP per capita is US\$ 4802.¹⁶⁰

A cross-sectional analysis of the economic impact of unnecessary proton pump inhibitors in Lebanon, an upper middle-income country. The proportion of overuse was 71.4% (714/1000 individuals), with an estimated annual waste of US\$ 25 million.¹⁷⁰

Solutions for the problem of overuse (42 studies; Table 3)

A before-and-after study evaluated the effect of an intervention (training and pulse oximeters) on the appropriate use of oxygen among 1 765 patients in a teaching hospital in Rwanda, a low-income country. Oxygen use in the emergency department decreased from a median of 32.0 (IQR: 28.0–35.0) tanks per day to 16.0 (IQR: 12.5–21.0) tanks per day at week 12. The proportion of appropriate use of oxygen therapy increased from 18.7% (34/182) at baseline to 42.0% (42/100) at 12 weeks.³²⁹

A multicentre RCT of the effect of point-of-care CRP testing on the inappropriate use of antibiotics for non-severe acute respiratory infections among 2037 patients in 10 Vietnamese primary health-care centres. The

number of patients who used antibiotics within 14 days was 581 (64.4%) of 902 patients in the CRP-group versus 738 (77.9%) of 947 patients in the control group (OR: 0.49; 95% CI: 0.40–0.61).¹¹⁵

CI: confidence interval; CRP: C-reactive protein; GDP: gross domestic product; IQR: interquartile range; OR: odds ratio; RCT: randomized control trial; US\$: United States dollars; WHO: World Health Organization.

Note: Results reported in the box are based on key studies that we have selected to represent different countries (i.e. income group or WHO region) and main theme or focus (e.g. solution or estimate). However, these studies were conducted in local settings and might not be representative to the wider low- and middle-income countries context. Therefore, generalizability of these findings to the low- and middle-income countries context is limited and should be done with extreme caution.

Table 1. Characteristics of the 367 included studies in the scoping review on overuse of medications in low- and middle-income countries

Study characteristic	Study reference	No. (%) of studies
Publication year		
1990–2000	23,50,67,113,168,185,187,201,233,248	10 (2.7)
2001–2010	18,22,49,54,56,57,71,85,95,110,145,159,169,172,181,193,195,202,213,256,264,270,285,289,291,295,318	27 (7.4)
2011–2021	15–17,19–21,24–48,51–53,55,58–66,68–70,72–84,86–94,96–109,111,112,114–144,146–158,160–167,170,171,173–180,182–184,186,188–192,194,196–200,203–212,214–232,234–247,249–255,257–263,265–269,271–284,286–288,290,292–294,296–317,319–381	330 (89.9)
Language of publication		
English	15,17–21,24–49,51–66,68–91,93–132,134–165,167,168,170–213,215–224,226,228–235,238–266,268–270,272,273,275–289,291–329,331–381	347 (94.6)
Spanish	50,90,133,169,227,236,237,267,271,274,290	11 (3)
French	16,23,67,166	4 (1.1)
Portuguese	22,92,214,225	4 (1.1)
Russian	330	1 (0.3)
No. of countries included in the study		
One	15–23,25–52,54–57,59–72,74–82,84,85,87–138,141–147,149–169,171–179,181–200,202–208,211–221,223–331,334–346,348–381	346 (94.3)
Multiple countries	24,53,58,73,83,86,139,140,148,170,180,201,209,210,222,242,297,326,332,333,347	21 (5.7)
Country income level		
Low income	18,20,21,38,67,75,77,111,127,129,144,146,166,183,230,231,245,249,256,262,316,329,335,337,343	25 (6.8)
Lower-middle income	16,17,23,25,27–29,31,43,45,51,52,55,61,64,68,69,71,72,74,78,79,81,85,93,99,108,114,117,122,124,130,131,134,145,150,155,159,167,168,175,179,181,182,185,186,191–194,197,220,226,229,234,235,240,241,246,247,251–253,260,261,263,265,275,281,284,287,288,293,295,298,301,302,307,308,310–313,315,319,339,346,353,356	89 (24.3)
Upper-middle income	15,19,22,26,30,32–37,39–42,44,46,47,49–51,54,56,57,59,60,62,63,65,66,70,76,80,82,84,87–92,94–98,100–107,109,110,112,113,115,116,118–121,123,125,126,128,132,133,135–138,141–143,147,149,151–154,156–158,160–165,169,171–174,176–178,184,187–190,195,196,198–200,202–208,211–219,221,223–225,227,228,232,233,236–239,243,244,248,250,254,255,257–259,264,266–274,276–280,282–286,289–292,294,296,299,300,303–306,309,314,317,318,320–325,327,328,330,331,334,336,338,340–342,344,345,348–352,354,355,357–381	232 (63.2)
World Bank geographical region^a		
Sub-Saharan Africa	20,21,25,27,28,31,45,55,67,75–77,108,111,122,124,127,129–131,135,144,146,166,168,183,185,197,220,226,228,230,231,245,249,256,261–263,282,287,288,295,316,329,335,337,343,349	49 (13.4)
East Asia and the Pacific	15,19,26,30,33,34,50,56,65,66,97,98,100–103,106,115,117–119,121,132,149,151,154–156,160–162,164,165,167,172,174,177,179,190,196,199,200,203–208,211,212,215,217,218,223,233,239,252,253,255,257,260,264,268,276,277,279,285,307,309,318,323,327,328,331,338,351,352,356–369,371,372,376–381	99 (28.9)
Europe and Central Asia	32,35,39,51,54,59,60,62,70,80,84,91,94,95,107,125,126,128,150,152,157,158,176,178,187–189,198,202,250,265,266,276,283,296,303,304,306,310,317,320,322,324,325,330,334,336,340,342,344,345,350,370,373	54 (15.7)
Latin America and the Caribbean	22,37,40,42,44,63,82,87,88,90,92,104,105,109,110,112,113,116,120,133,136–138,141–143,147,169,171,184,195,213,214,216,219,221,224,225,227,236–238,243,248,254,258,259,267,269,270,273,274,286,289,290,299,300,305,341,348,354,355	62 (18.1)
Middle East and North Africa	16–18,23,36,38,41,43,46,47,49,57,74,89,96,123,153,163,173,175,186,232,240,244,272,280,291–294,314,374,375	33 (9.0)
South Asia	29,48,52,61,64,68,69,71,72,78,79,81,85,93,99,114,134,145,159,181,182,191–194,229,234,235,241,246,247,251,271,275,281,284,298,301,302,308,310–313,315,319,339,346,353	49 (13.4)
Study design		

Interventional (e.g. RCT)	37,45,50,52,55,65,66,98,106,108,114,117,176,186,189,192,201,215,231,234,236,240,249,260,267,299,313,329,341,347,356,359,363,368,369,378	36 (9.8)
Randomized trials (e.g. cluster RCTs)	45,55,98,117,231,240,249,341,347,359,369	11 (3.0)
Controlled studies	37,52,66,106,201,267,299,313,368,378	10 (2.7)
Before and after studies	50,65,108,114,176,186,189,192,215,234,236,260,329,356,363	15 (4.1)
Observational	15–23,25–36,38,40,42–44,46,48,51,54,56–64,67–72,74–77,79–85,87–97,99–105,107,109–113,115,116,118–120,122–138,140–147,149–175,177–185,187,188,190,191,193–200,202–208,211–214,216–221,223–230,232,233,235,237–239,241–248,250–259,261–264,266,268–271,273–298,300–312,314–325,327,328,330–340,342–346,348–355,357,358,360–362,364–367,370–377,379–381	313 (85.3)
Cross sectional (e.g. survey)	16–23,25,26,28–36,38,40,42–44,46,51,54,57–64,67–72,74–76,79,80,84,85,87–97,100–105,107,109–113,115,116,118,120,123–127,129–132,134,135,138,140,142–144,146,149,150,152,153,155–158,160–165,167,169–171,173,174,178–181,185,187,190,191,193–197,199,202–204,206,208,211–214,217–219,221,224–227,229,230,232,233,237,239,243–245,247,251,252,254–259,261–264,266,269,270,273–275,277–281,283–294,296–298,300–304,306–308,310–312,314–317,320–322,324,327,328,330,332–339,343–345,348–352,354,357,358,360–362,364–367,370–372,374–377,379–381	257 (70.0)
Cohort (prospective or retrospective)	81–83,122,128,137,154,159,172,175,182,184,188,198,200,216,220,228,235,238,241,250,268,271,276,282,295,305,309,319,323,325,331,340,346,353,373	37 (10.1)
Others (e.g. Delphi or ecological studies)	15,27,48,56,99,119,132,145,147,151,166,168,177,179,183,223,242,246,342	19 (5.2)
Secondary research (e.g. review)	24,39,41,47,49,53,73,78,86,121,139,148,209,210,222,265,272,326	18 (4.9)
Health-care settings		
Hospital-based or secondary care	16,17,20,21,23,26,29–31,33,35–37,39,41,42,46,49,51,55,56,59–62,65,66,71,72,75,76,79–82,84,87–90,93–97,99,101,106,107,109,113,115,125,126,128,130–134,136,137,140,141,143,146,147,150–152,154,155,159,162–165,168,172,175,177,178,181,182,184,185,187–189,191,192,197–200,203,205,207,212,213,215,217–221,223,224,229,230,233–237,239,241,243,244,248,250,253,257,260–263,267,268,270,271,273,274,276,277,282,285,288–290,294,295,297–299,301,302,306,308,310–313,316–319,321,323,325,327–336,338–340,342,343,345,346,348,350,353–356,358,361,365,372,374–381	195 (53.1)
Home-based or community or primary care	18,19,22,25,27,28,34,38,40,43–45,48,52–54,57,58,64,68,69,73,74,77,86,92,98,100,102–105,108,111,112,114,116–120,122–124,127,129,135,138,144,145,149,153,156–158,160,161,167,169–171,176,180,190,193–196,202,204,206,214,216,225–228,232,238,240,242,245,249,252,254,256,258,259,264–266,269,278–280,283,284,286,291–293,300,303–305,307,309,322,324,326,337,347,351,352,357,359,360,366,368–371,373	123 (35.1)
Mixed	15,24,47,67,91,110,121,139,142,148,166,183,186,201,210,211,222,247,272,275,281,287,296,344,349,363	26 (7.1)
Unclear or not applicable	32,50,63,70,78,83,85,173,174,179,208,209,231,246,251,255,314,315,320,341,362,364,367	23 (6.3)
Analysis approach		
Quantitative	15–17,19–23,25,26,29–32,34–42,44–46,49–51,53–66,70,72–91,93–95,97–104,106–117,120,122–147,149–165,167–170,172–185,187–192,195–200,202–208,211–230,232–243,245,246,248–250,253–255,257–259,261,263,264,266–268,270–274,276–282,284–313,315–331,334,336–338,340–353,355–361,364,365,367–370,372–381	316 (86.1)
Qualitative	24,27,33,43,47,48,68,96,118,119,166,193,194,201,244,247,251,256,260,265,269,275,283,332,333,339	26 (7.1)
Mixed	18,28,52,67,69,71,92,105,121,148,171,186,209,210,231,252,262,314,335,354,357,362,363,366,371	25 (6.8)
Condition or systems treated^P		
Infectious	15,18,21,24,26,29,30,37,38,43,45,53,55,58,64,67,73,75,87,95,97,101,108,110,114,117,120,127–129,141,144,147,148,154,155,163,170,172,178,181–183,186,187,190,192–194,202,203,207,210,213,220,223,228,230,231,233–	86 (23.4)

	235,241,246,249,255,256,260,261,282,284,295,307,314– 316,319,327,329,332,339,347,364,367,369,380	
Cardiovascular	20,33,36,39,42,46,70,77,103,107,112,132,143,146,157,158,174,184,188,197,204,206,208,217,218,221, 236,238,239,241,243,270,284,286,297,300–302,304,305,312,330,336,337,346,358,374,379	48 (13.1)
Respiratory	23,56,88,100,103,123,132,143,152,157,179,180,184,204,208,221,257,265,268,273,302,306,309,312,32 5,330,336,344–346,350,358	32 (8.7)
Diabetes	32,33,42,70,77,83,84,103,157,158,174,204,208,217,238,241,248,270,286,300,302,304,310,312,320,32 1,336,337,342,355,375	31 (8.4)
Mental health	23,33,35,36,44,54,64,73,75,138,142,195,198,199,213,219,226,232,238,239,253,300,302,305,311,317,3 37,341,375	29 (7.9)
Gastrointestinal	41,64,73,82,122,124,132,143,173,179,188,199,211,212,215,237,243,263,264,287,328,343,353,362	24 (6.5)
Genitourinary	23,36,73,80,93,96,109,132,145,157,198,236,250,323,346,377	16 (4.4)
Other (e.g. cancer and skin)	39,42,62,72,115,157,177,185,188,214,221,238,239,262,286,287,302,305,313,329,331,340,348,372	24 (6.5)
Not specified	16,17,19,22,25,27,28,31,34,40,47–52,57,59–61,63,65,66,68,69,71,74,76,78,79,81,85,86,89– 92,94,98,99,102,104–106,111,113,116,118,119,121,125,126,130,131,133–137,139,140,149– 151,153,156,159–162,164– 171,175,176,189,191,196,200,201,205,209,216,222,224,225,227,229,240,242,244,245,247,251,252,25 4,258,259,266,267,269,271,272,274–281,283,285,288– 294,296,298,299,303,308,318,322,324,326,333–335,338,349,351,352,354,356,357,359– 361,363,365,366,368,370,371,373,376,378,381	156 (42.5)
Medication class^b		
Antimicrobials	15,17,18,21–30,38,45,48–50,52,53,55,56,58,61,64,65,67–71,73,75,80,81,84,87,88,91,95– 101,103,108,110,111,113,114,117–129,135,141,144,147,149,156,163,167– 169,171,175,179,185,187,192,202,203,205,209,222,223,228,230,231,234–236,245– 247,249,251,252,255,256,260,263–265,269,272,274,279,282,283,285,287,288,290,293–296,298– 300,307,309,313–316,319,326–328,331,332,339,343,347,350,353,357,360,362–364,366– 369,371,376,380,381	152 (41.4)
Psychotropic drugs ^b	19,31,34–37,40,42,44,54,57,60,63,70,92,102,104,106,107,116,131–133,136– 138,142,143,157,158,160,161,168,169,174,176,178,181,182,184,188,196,198,199,204,206,208,213,21 6–219,221,225,227,232,238,239,241,243,248,250,253,266,270– 272,276,286,289,297,300,302,304,305,311,312,317,318,330,336,348,349,352,354,356,358,361,374,37 5,379	91 (24.8)
Blood pressure lowering and cardiovascular medications	20,25,33,34,36,39,42,44,54,77,80,89,92,104,107,112,132,138,143,146,150,158,160– 162,165,169,182,188,196,197,199,204,206,208,213,216– 218,221,225,227,229,236,238,239,243,248,250,258,266,272,277,291,297,300,302,305,317,320– 322,324,330,334,337,338,341,346,349,352,353,370,374,375,379	76 (20.7)
Analgesics and steroids	19,25,31,34,36,39,40,43,44,60,67,70,80,88,96,104,106,116,131,138,140,143,146,150,152,159,169,176, 180– 182,184,188,195,196,198,204,213,226,229,236,238,239,246,250,257,272,273,276,277,286,291,297,30 0,302–304,310,317,325,330,336,337,340,344,346,349,352–354,375	71 (19.3)
Proton pump inhibitors and antacids	33,39– 42,44,79,82,89,90,94,96,107,109,132,134,165,173,176,178,188,196,200,204,212,215,218,221,225,227, 236,237,241,246,248,266,276,277,280,286,303,310,312,336,346,352,353,358,361,365,374,375,378	53 (14.4)
Hypoglycaemic and hormonal medications	32,34,39,44,77,80,83,103,112,143,158,160,161,169,206,208,216,217,248,266,300,304,312,320,321,34 2,349,355,375,376	30 (8.2)
Others	16,25,72,74,85,115,162,214,246,258,262,322,324,329,338,370,372,377	18 (4.9)
Not specified	46,47,51,59,62,66,76,78,86,93,105,130,139,145,148,151,153–155,164,166,170,172,177,183,186,189– 191,193,194,201,207,210,211,220,224,233,240,242,244,254,259,261,267,268,275,278,281,284,292,30 1,306,308,323,333,335,345,351,359,373	61 (16.6)

RCT: randomized controlled trial.

^a Twenty-one studies covered more than one region.

^b Not mutually exclusive.

^c Including antianxiety, antidepressant, anticonvulsant and antipsychotic.

Table 2. Studies included on the extent of overuse of medications in low- and middle-income countries

Study characteristic	Study reference	No. (%) of studies
Total	15,16,19–26,28,30–42,44–46,49–51,53,54,56–64,66,67,70–97,100–102,104–107,109–113,115,116,120–154,157–163,165,167–175,177–191,195–208,210–214,216–230,232–235,237–243, 245,248–250,252–259,261–264,266–273,276–282,284–298,300–312,314–328,330,332,334,336–338,340,342–346,348–355,358,360–362,364–368,370,372–377,379	307 (83.7) ^a
Country income level^b		
Low	20,21,38,67,75,77,111,127,129,144,146,170,183,230,245,249,256,262,316,337,343	21 (6.8)
Lower middle	16,23,25,28,31,45,61,64,71,72,74,78,79,81,85,93,122,124,130,131,134,145,150,159,167,168,175,179,181,182,185,186,191,197,220,226,229,234,235,240,241,252,253,261,263,281,284,287,28 8,293,295,298,301,302,307,308,310–312,315,319,346,353	63 (20.5)
Upper middle	15,19,22,26,30,32–37,39–42,44,46,49–51,54,56,57,59,60,62,63,66,70,76,80,82,84,87–90,92,94–97,100–102,104–107,109,110,112,113,115,116,120,121,123,125,126,128,132,133,135– 138,141–143,147,149,151–154,157,158,160–163,165,169,171–174,177,178,184,187–190,195,196,198–200,202–208,211–214,216–219,221,223–225,227,228,232,233,237–239,243,248,250, 254,255,257–259,264,266–270,272,273,276–280,282,285,286,289–292,294,296,300,303–306,309,314,317,318,320–325,327,328,330,334,336,338,340,342,344,345,348–352,354,355,358, 360–362,364–368,370,372–377,379	205 (66.8)
Medication class		
Antimicrobials	15,21–26,28,30,38,45,49,50,53,56,58,61,64,67,70,71,73,75,80,81,84,87,88,95–97,100,101,110,111,113,120–129,135,141,144,147,149,163,167–169,171,175,179,185,187,202,203,205,222, 223,228,230,234,235,245,249,252,255,256,263,264,269,272,279,282,285,287,288,290,293–296,298,300,307,309,314–316,319,326–328,332,343,350,353,360,362,364,366–368,376	110 (35.8)
Low-income country	21,38,67,75,111,127,129,144,230,245,249,256,316,343	14 (12.7)
Lower-middle-income country	23,25,28,45,61,64,71,81,122,124,167,168,175,179,185,234,235,252,263,287,288,293,295,298,307,315,319,353	28 (25.5)
Upper-middle income country	15,22,26,30,49,50,56,70,80,84,87,88,95–97,100,101,110,113,120,121,123,125,126,128,135,141,147,149,163,169,171,187,202,203,205,223,228,255,264,269,272,279,282,285,290,294,296, 300,309,314,327,328,350,360,362,364,366–368,376	61 (55.5)
Psychotropic drugs ^c	19,31,34–37,40,42,44,54,57,60,63,70,92,102,104,106,107,116,131–133,136–138,142,143,157,158,160,161,168,169,174,178,181,182,184,188,196,198,199,204,206,208,213,216–219,221,225, 227,232,238,239,241,243,248,250,253,266,270–272,276,286,289,297,300,302,304,305,311,312,317,318,330,336,348,349,352,354,358,361,374,375,379	89 (30.0)
Low-income country	N/A	0 (0.0)
Lower-middle income country	31,131,168,181,182,241,253,302,311,312	10 (11.2)
Upper-middle income country	19,34–37,40,42,44,54,57,60,63,70,92,102,104,106,107,116,132,133,136–138,142,143,157,158,160,161,169,174,178,184,188,196,198,199,204,206,208,213,216–219,221,225,227,232,238,239, 243,248,250,266,270,272,276,286,289,300,304,305,317,318,330,336,348,349,352,354,358,361,374,375,379	77 (86.5)
Antihypertensive	20,25,33,34,36,39,42,44,54,77,80,89,92,104,107,112,132,138,143,146,150,158,160–162,165,169,182,188,196,197,199,204,206,208,213,216–218,221,225,227,229,238,239,243,248,250,258, 266,272,277,291,297,300,302,305,317,320–322,324,330,334,337,338,346,349,352,353,370,374,375,379	74 (24.1)
Analgesics and steroids	19,25,31,34,36,39,40,44,60,67,70,80,88,96,104,106,116,131,138,140,143,146,150,152,159,169,180–182,184,188,195,196,198,204,213,226,229,238,239,250,257,272,273,276,277,286,291, 297,300,302–304,310,317,325,330,336,337,340,344,346,349,352–354,375	67 (21.8)
Proton pump inhibitors and antacids	33,39–42,44,79,82,89,90,94,96,107,109,132,134,165,173,178,188,196,200,204,212,218,221,225,227,237,241,248,266,276,277,280,286,303,310,312,336,346,352,353,358,361,365,374,375	48 (15.6)
Methods for assessing overuse		
Local professional norms or guidelines	16,22–25,32,35,41,44,46,49,53,58,61,66,67,70–73,76,81–83,85,87,88,90,93–95,97,100,101,110,113,115,120,123–126,128,129,134,141,151–154,160,161,163,167,168,170,172,175,177–181, 183,185,195,197,202,205,207,211,214,219,221,224,226,228,230,237,248,257,261,262,264,266,282,284,285,287–290,294,295,298,306,307,309,316,319,323,325,326,328,334,343,345, 350,353,360,362,368,376,377	114 (37.1)
Beers criteria® for Potentially Inappropriate Medication Use in Older Adults	19,31,36,39,40,51,54,57,60,63,77–79,89,92,96,102,104–106,109,112,116,130,131,133,136–138,142,143,150,158–161,165,169,182,184,191,196,198,199,206,213,216,218,225,227, 229,238,239,253,254,258,259,270,271,281,286,291,297,301,302,305,310–312,324,330,337,346,349,352,354,358,361,373,375	80 (26.1)
Screening tool of older person's prescriptions	20,33,34,59,60,78,102,107,130,132,133,142,146,161,184,188,196,199,204,217,218,225,229,243,250,253,254,258,311,317,337,352	32 (10.4)

N/A: not applicable.

^a The denominator is all 367 studies included in the scoping review.

^b Including only single country studies.

^c Including antianxiety, antidepressants and antipsychotics.

Table 3. Studies included on the drivers, solutions and consequences of medication overuse in low- and middle-income countries

Study characteristic	Study reference	No. (%) of studies
Drivers	15,18,20,27–30,32,36,40,43,44,47,48,52–54,60,63,68,69,71,77,79,82,86,88–92,96,99,102,104,105,111,113,115,118,119,121,127,129,130,132,135–139,144,151,153,155,156,159,162,164–166,173–175,183,190,193,194,196,198,199,204,206,208,210,213,216–218,221,222,226,228,229,234,235,238,239,244,246,247,250–252,260,262,275,277,278,283,284,286,291,292,295,297,300,302–304,307,309,310,312,317,319,321,322,326,327,332,333,337–340,342,346,350,352,354,357,358,362,364,366,368,371,379	139 (37.9) ^a
Individual-level factors	27,29,40,43,47,48,53,60,63,69,71,77,79,82,86,88–90,92,96,99,102,104,105,118,119,121,127,130,136–139,144,151,153,155,156,159,165,166,173–175,190,193,196,208,210,213,229,238,247,250,251,260,283,286,291,300,302–304,310,312,332,337,339,354,357,358,366,371,379	74 (53.2)
Polypharmacy and/or multimorbidity	27,40,60,63,77,79,86,88–90,92,96,102,104,105,130,136–139,159,165,174,196,208,213,229,250,286,291,300,303,304,310,337,354,358,379	38 (51.4)
Limited knowledge	29,47,48,69,82,99,118,119,121,127,144,166,175,190,210,238,250,251,283,302,312,332,357,371	24 (32.4)
Patients demand	43,47,48,53,71,193,210,247,260,339,366,371	12 (16.2)
System-level factors	15,18,28,40,43,47,48,52,68,69,71,89,92,99,111,113,119,127,130,139,151,156,164,166,190,193,196,210,213,246,247,251,260,283,310,332,333,357,366,371	40 (28.8)
Constrained resources	18,28,48,68,69,71,111,139,166,190,210,247,251,260,333,357	16 (40.0)
Financial factors	15,47,48,119,164,166,193,210,247,251,283,366,371	13 (32.5)
Regulatory issues	15,43,48,69,99,119,127,193,251,332,371	11 (27.5)
Other	18,40,52,89,92,113,130,151,156,196,213,246,310	13 (32.5)
Consequences	21,23,33–35,37,39,46,74,81,103,112,116,142,143,179,203,242,265,268,274,280,294,308,315,318,331,361,365,374,380	31 (8.4) ^a
Potential solutions	17,25,43,48,55,64,66,98,99,106,114,117,141,147,170,176,186,189,193,200,201,205,209,215,231,236,240,249,274,276,299,305,313,329,335,341,347,356,359,363,378,381	42 (11.4) ^a
Study design		
Interventional	55,66,98,106,114,117,176,186,189,201,215,231,236,240,249,299,313,329,341,347,356,359,363	23 (54.8)
Observational	17,25,43,48,64,99,141,147,170,193,200,205,209,274,276,305,335,378,381	19 (45.2)
Medicine focus		
Antibiotics	17,25,48,55,64,98,99,114,117,141,147,205,209,231,236,249,274,299,313,347,363,381	22 (52.4)
Others	43,66,106,170,176,186,189,193,200,201,215,240,276,305,329,335,341,356,359,378	20 (47.6)

^a The denominator is all 367 studies included in the scoping review.

Fig. 1. Flowchart of the selection of articles included in study on overuse of medications in low- and middle-income countries

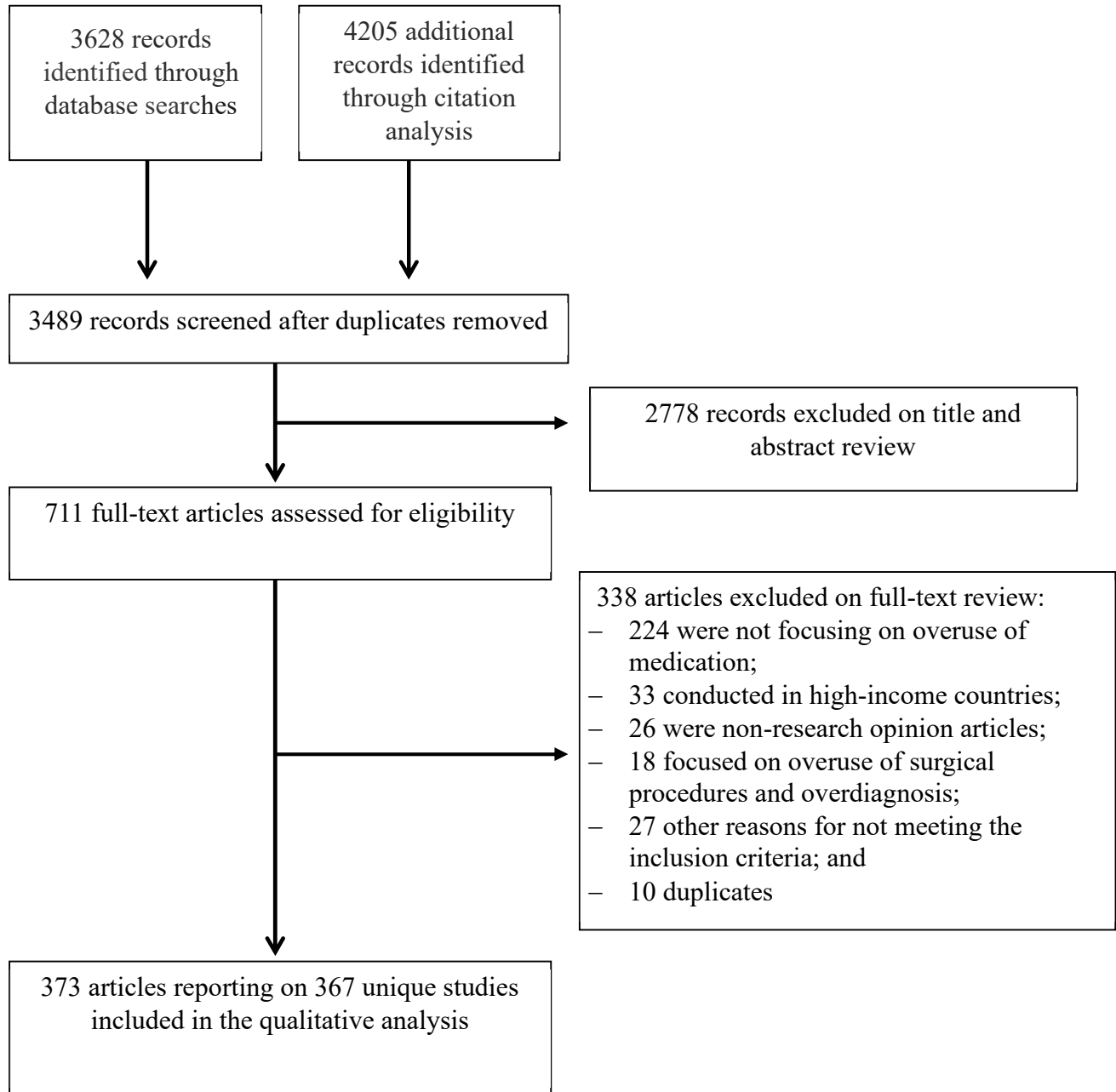


Fig. 2. **Studies of overuse of medications in low- and middle-income countries**

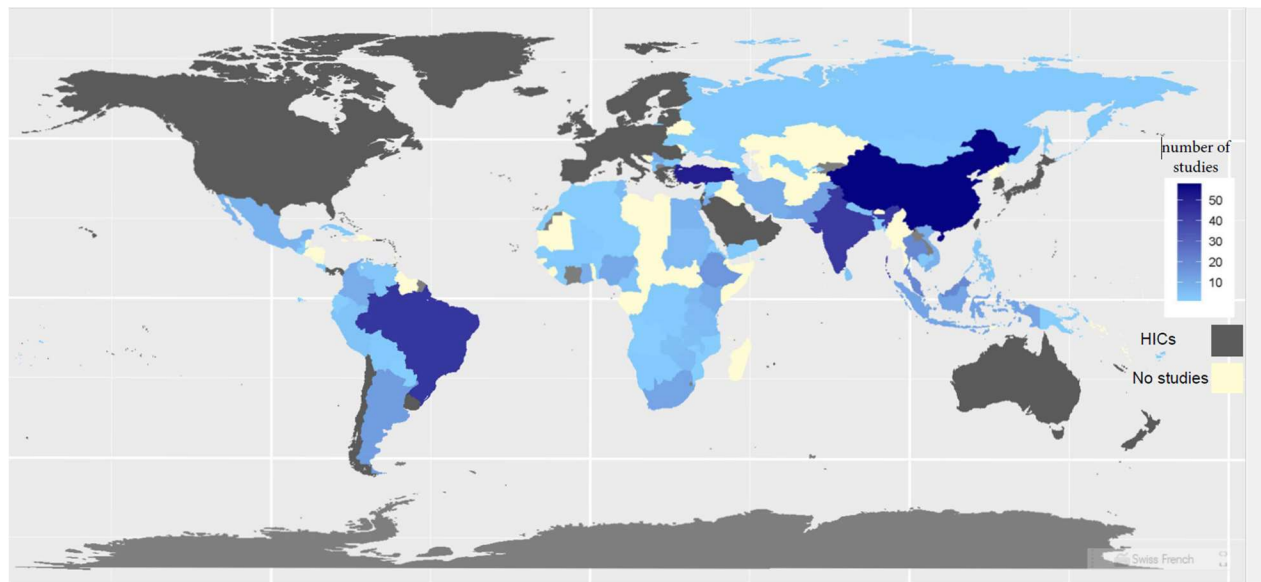


Fig. 3. The distribution of studies of overuse of medications in low- and middle-income countries per average percentage of overuse in studies from each country

