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National essential medicine lists, 2017–2023

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Abstract

Regularly updating national essential medicines lists promotes access to treatments for priority health needs and maintains confidence in medicine selection. Since 1977, the World Health Organization (WHO) has issued biennial updates to the *WHO Model list of essential medicines*. Countries are encouraged to revise their own national lists on an ongoing basis, although not necessarily at the same frequency as WHO. We assessed current engagement with the concept of essential medicines lists globally by tracking changes in national essential medicines lists between 2017 and 2023. We identified 158 national lists that collectively included 2084 unique medicines. Most lists (66.5%, 105/158) had been updated since 2017 and 15.2% (24 lists) were new lists. Only 18.4% (29/158) of lists were unchanged since 2017. Alignment with the 2023 WHO model list varied, with differences ranging from 54 to 762 medicines. The median lag time between a medicine being added to the WHO model list and to national lists was about 2 years, but the time varied. Countries' engagement with the concept of essential medicines has increased which might help respond to current and future challenges in the provision of medicines, such as high medicine costs. National lists need to be updated regularly and this process can be facilitated by following WHO guidance on selection of essential medicines. Countries must select medicines appropriate for their population needs and ensure adequate access to these medicines.

Introduction

Fifty years after the 1975 World Health Assembly charged the World Health Organization (WHO) with assisting Member States in selecting and procuring medicines, countries continue to create and update their national medicines lists in ways that largely, but not perfectly, align with the *WHO Model list of essential medicines*.[1] This alignment is remarkable given the current challenges created by the high cost of medicines and diminishing available resources for health care. Even amidst "severe worldwide economic difficulties," the "high cost of drugs" with some

having “spiralled in price, in some cases by as much as 600%” was the first issue highlighted to the World Health Assembly by the Sri Lankan health ministry in 1975.[1] The need to carefully select medicines has grown over the past 50 years: now more than 1 trillion United States dollars are spent on medicines globally, while many high-cost medicines are of questionable value. The need for careful medicine selection increases whenever a new medicine is made available. Therefore, adequate resources to support international guidance, such as from the WHO model list, are even more important now that a single medicine can cost millions of dollars.

Updating national essential medicines lists is vital to ensure the availability of newer treatments that address the priority health needs of the population, and to remove outdated medicines from the lists as needed.[2] Since 1977, WHO has been updating its model list every 2 years and guidance indicates that countries should update their lists regularly, although the pace may be different from that of WHO.[3]

National lists are widely implemented although their adoption does not guarantee better medicine access or use.[4] Some countries use their national lists to determine which medicines are publicly funded, others use the lists as guidance to clinicians and patients, while some countries do not have an essential medicines list. A previous study showed that most national lists in 2017 diverged widely from the WHO model list.[4] Differences between national lists are not always explained by differences in the health needs of populations or by the level of health-care resources available in the country, and analyses of national lists have identified potential changes that could promote health, such as using international guidance to add medicines for priority conditions and removing other medicines that may provide less value.[4–6] Access to essential medicines is explicitly a part of universal health coverage, a sustainable development goal,[7] and has been recognized as a main aim by the World Health Assembly since 1978.[2] Therefore, action on and engagement with national lists is an indicator of progress towards internationally recognized health priorities.

Assessing current engagement

We assessed current engagement with the concept of the WHO model list globally by tracking changes in national lists between 2017 and 2023.[8] In May of 2023, we made web searches for national lists and government (e.g. ministry of health) websites. We also contacted listed technical officers responsible for access to health care for all countries where WHO has country

offices. Additionally, we contacted WHO regional technical officers and experts studying selection of essential medicines and implementation of national lists who might have access to documents related to these lists. We included both outpatient and inpatient lists across different levels of care (primary, secondary, tertiary and quaternary). We included lists published in all languages. We excluded prescribing guideline documents that were not lists of medicines. For each national list,[9] we recorded the listed medicines using international nonproprietary names (INN). We listed medicines individually if they were part of a combination product; for example, if a national list gave efavirenz in combination with emtricitabine and tenofovir, we recorded it as efavirenz, emtricitabine and tenofovir individually. We excluded diagnostic agents, antiseptics, disinfectants, saline solutions and naturopathic medicines as they are not always referred to as medicines.

We used a combination of a computer and manual approaches for abstracting medicines from each list, depending on the formatting of the list documents.[4] We used the Anatomical Therapeutic Chemical (ATC)–Defined Daily Dose index file obtained from the website maintained by the Norwegian Institute of Public Health and WHO Collaborating Centre for Drug Statistics Methodology on 29 March 2023. The algorithm was a web scraper designed to match medication names with their corresponding ATC codes. We verified the accuracy of the computer abstraction process by randomly selecting data points (whether a specific medicine was listed by a particular country) and checking them manually against the original list document. The error rate was $0.6\% \pm 4.9\%$ (3 errors in 400 data points).

Our survey of national list changes includes a large number of countries. However, although we conducted a rigorous search, we may have missed some national essential medicines lists such as those that are not publicly posted. Additionally, other countries may have subnational lists or other processes for ensuring medicine access that were not captured as our study which focused on national essential medicines lists. We had to make some judgements about what to consider a medicine, for example, we did not include traditional medicines such as herbal medicines, supplements and contrast media, and we separated fixed-dose combinations into their individual components. Furthermore, we did not capture data on formulations, dosages or strengths, nor did we capture whether the medicines listed were specified for inpatient or outpatient settings. National lists are used differently in different jurisdictions and listing a medicine on such a list does not necessarily mean it is available. Our calculations on time to

inclusion or removal may not capture exactly when medicines were added to national lists, since we made cross-sectional comparisons of national lists identified in 2017 and national lists identified in 2023. We also did not investigate how well national lists fulfilled the other important elements in guiding selection and appropriate use of medicines. List documents varied in whether they provided direction about indications for medicine use, which formulations should be used for children and other important factors.

Changes to the WHO model list

Since 2017, WHO has added or removed 153 medicines from its model list (Table 1 and online repository).[10] Comparing the 2023 WHO model list with the 2017 version, 143 medicines were added: 38 in 2019, 76 in 2021 and 29 in 2023. Since 2017, 12 medicines have been removed: eight in 2019, none in 2021 and four in 2023. Kanamycin injection for treatment of multidrug-resistant tuberculosis was removed from the WHO model list in 2019, and topical kanamycin for treatment of ocular infections was added in 2021 as a therapeutic alternative to gentamicin. For each of the 142 medicines added to the WHO model list since 2017 (excluding kanamycin), we recorded the number of countries (out of the 95 countries that had updated their list since 2017) that also added the medicine to their lists during this period. We found that across these 142 medicines, the median number of countries adding a medicine was 11.0 (interquartile range, IQR: 5.0 to 15.8). By 2023, the 142 medicines added to the WHO model list were also listed in the national lists of a median of 35.5 (IQR: 16.0 to 50.0) countries out of all 158 national lists. The medicines added to the WHO model list that were most commonly added to national lists were rivaroxaban (added to 36 national lists), abiraterone (added to 30 national lists), levetiracetam (added to 29 national lists) and sevoflurane (added to 28 national lists). For the 11 medicines removed from the WHO model list since 2017, a median of 3.0 (IQR: 1.0 to 7.5) countries (out of the 95 countries that updated their list since 2017) also removed the medicine from their lists during this period. By 2023, the 11 medicines removed from the WHO model list were still listed by a median of 18.0 (IQR: 12.5 to 42.0) countries out of the 158 national lists. The medicines removed from the WHO model list that were most commonly removed by national lists were peginterferon alfa-2b (removed from 12 national lists), capreomycin (removed from 11 national essential medicines lists) and peginterferon alfa-2a (removed from 10 national lists since 2017). Peginterferon alfa-2a and alfa-2b were removed from the WHO model

list due to possible side-effects during treatment and potentially irreversible long-term side-effects. Capreomycin was removed from the WHO model list in alignment with updated guidelines on multidrug-resistant tuberculosis. We explored reasons why WHO added medicines to or removed medicines from the WHO model list (online repository).[10] Reasons for adding medicines included evidence supporting favourable benefit-to-harm ratios, public health importance and the need for multiple therapeutic alternatives to increase market competition and reduce costs.

Time to changes in national lists

We calculated the time difference between inclusion on or removal from the WHO model list and national updates by subtracting the years in which the change was made on the WHO model list and on the national list; we focused on the 95 national essential medicines lists that were updated since 2017 (Table 1). The median time to inclusion of WHO additions was 2.0 years (IQR: 1.0 to 2.0 years) and the median time to removal was 0.0 years (IQR: 0.0 to 2.8 years). This figure was determined by calculating the median of the median times to inclusion for each individual medicine. For example, fexinidazole, which was added to the WHO model list in 2019, was added to five national lists between 2019 and 2023: Angola (time to inclusion of 2 years); Burkina Faso (time to inclusion of 1 year); Chad (time to inclusion of 3 years); Democratic Republic of the Congo (time to inclusion of 1 year); and Pakistan (time to inclusion of 2 years). Thus, the median time to inclusion was 2.0 years (IQR: 1.0 to 2.0 years). This median time was calculated for each medicine and the overall median of these median times to inclusion was 2.0 years.

When examining medicines by medicine class, the most commonly added medicine class to the WHO model list was antineoplastic agents (12 medicines, median time to inclusion on national lists 2 years), followed by immunosuppressants (eight medicines, median time to inclusion on national lists 2 years) and drugs for obstructive airway diseases (eight medicines, median time to inclusion 2 years; online repository).[10] The most commonly added antineoplastic medicine was bortezomib (added to 22 of 95 national lists) and the most commonly added immunosuppressant was lenalidomide (added to 26 national lists). Antithrombotic medicines (five medicines) and nasal preparations (two medicines) had the highest median time to inclusion on national lists (3 years). Fifteen large-molecule medicines were added to the WHO model list

and two were removed. The median time to inclusion of these medicines on national lists was 2 years and the median time to removal was 0.5 years (online repository).[10]

Updated national lists, 2023

We identified a total of 158 medicines lists in 2023, 147 essential medicines lists, and 11 other types of medicines list (e.g. reimbursement list), representing 81.4% (158/194) WHO Member States. Compared with the national lists identified in the 2017 study,[4] 66.5% (105/158) were revised lists, including 96 that had been revised since the 2017 update of our national essential medicines lists database, and nine that were revised before 2017 but had not been previously identified. Overall, 18.4% (29/158) of the lists were the same as the 2017 lists we identified, 12.7% (20/158) were new lists and 2.5% (4/158) were lists that we had not identified in 2017 (online repository).[10]

The 105 revised lists contained between 86 (Argentina) and 1046 medicines (Portugal), with a median of 379.0 medicines (IQR: 326.0 to 452.0). Compared with the previous versions of the lists, the total number of medicines added ranged from 10 (Argentina) to 424 medicines (Bulgaria), with a median of 99.0 (IQR: 68.5 to 153.0) medicines while the total removed ranged between three (Lebanon) and 647 (Syrian Arab Republic), with a median of 35.0 (IQR: 22.8 to 68.3). Some of the most frequently added medicines in the 129 revised, new or previously unidentified lists were: dolutegravir (added in 74 lists with a median time to inclusion of 3 years from its addition to the WHO model list), linezolid (in 55 lists, median time to inclusion 5 years), levofloxacin and raltegravir (in 54 lists, median time to inclusion 7 years and 4 years, respectively), tranexamic acid (in 52 lists, median time to inclusion 9 years), latanoprost (in 51 lists, median time to inclusion 8 years), moxifloxacin (in 50 lists, median time to inclusion 3 years), darunavir (in 48 lists, median time to inclusion 6 years) and docetaxel (in 46 lists, median time to inclusion 10 years). All of these medicines were also included in the 2023 WHO model list. The most commonly removed medicines included didanosine (removed from 63 lists with a median time to removal of 5 years from its removal from the WHO model list), stavudine (removed from 61 lists, median time to removal 4 years) and indinavir (removed from 48 lists, median time to removal 7 years). These medicines were removed from the WHO model list in 2015, 2017 and 2015, respectively.

The 24 lists not previously included in our 2017 revision contained between 39 (Spain) and 918 medicines (Greece), with a median of 305.5 medicines (IQR: 250.5 to 437.8).[4] The reimbursement lists tended to be longer than the median length of all national essential medicines lists. For example, Czechia's reimbursement list included 834 medicines, Slovakia's list included 764 medicines and Algeria's list included 516 medicines. However, some reimbursement lists included fewer medicines, such as Albania (305 medicines) and Romania (145 medicines). Details are provided in the online repository.[10]

Comparison of lists

Comparing country lists with the 2023 WHO model list (with 534 unique medicines listed), the number of differences ranged from 54 medicines (Pakistan) to 762 medicines (Portugal), with a median of 368.5 (IQR: 326.0 to 431.5; online repository).[10] Overall, the number of medicines listed by each country and not by the 2023 WHO model list ranged from 6 to 637 (median 76.0, IQR: 48.3 to 137.5), while medicines listed by the 2023 WHO Model EML and not included by countries ranged from 42 to 512 (median 262.0, IQR: 211.3 to 317.0). Overlap between the 2023 WHO model list and national lists varied substantially, with countries sharing as few as 22 medicines and as many as 492 medicines (median 272). The overlap percentage ranged from 38.6% (286/740) to 97.6% (492/504), with a median of 76.6%.

Comparing national essential medicines lists with each other, the 2023 similarity scores ranged from −542 medicines (Portugal) and +195 medicines (Sao Tome and Principe), with a median of 98.5 (IQR: 3 to 136). The similarity score for each country was the medicines on that list that are commonly listed (by at least 50.0% of countries) minus the number of uncommonly listed medicines (by less than 50.0% of countries).[4] This calculation provides a similarity integer score for each country where positive scores indicate that most medicines in the country's list are commonly listed by other countries and negative scores indicate that most medicines are uncommonly listed by other countries. We also compared the similarity score trends across countries, calculated as the difference between 2023 and 2017 scores in all 134 countries included in both data sets. Based on the 2017 data, the median similarity score was 81.0 (IQR: −44.3 to 114.8). Many countries show positive differences (e.g. Afghanistan +32, Gambia +51 and Slovakia +183), suggesting that their national lists are converging with those of other countries over time. A small number of countries had negative differences (e.g. Bangladesh −17,

Colombia −132 and Russian Federation −86), indicating divergence from other countries. This divergence could reflect delays in updates, the inclusion of medicines not aligned with WHO recommendations, or the removal of commonly listed medicines. A smaller subset of countries (e.g. Armenia +17 and Democratic Republic of the Congo +14) showed only minor changes, suggesting relatively stable alignment across periods. Thus, while the general tendency leans towards convergence in several countries, the presence of substantial divergences in others highlights persistent heterogeneity in how national lists evolve over time.

Although many medicines added to the WHO model list between 2017 and 2023 were also added to national lists, notable exceptions were seen. For some medicines, more countries removed them from national lists than added them, resulting in an overall decline in global coverage. Examples include bromocriptine, carbimazole, cetirizine, conjugated estrogens, fexofenadine and indomethacin. Conversely, some medicines removed from the WHO model list were still added to national lists after their removal from the WHO list, such as capreomycin, cefepime and ceftaroline, highlighting that national priorities do not always follow WHO decisions.

We found no obvious relationship between country characteristics and the length of national essential medicines lists, but countries with a lower health expenditure tended to list fewer medicines (*P*-value: 0.03) although many exceptions were seen (Fig. 1).

Implications for national lists

Some national essential medicines lists are similar to the WHO model list while others differ substantially, both from the WHO model list and from other national lists. Different health priorities or medicine selection challenges of countries, such as limited medicine selection capacity, lack of locally relevant data and the influence of nongovernmental actors including pharmaceutical companies, may explain the variability.[13] The WHO model list added more than 100 medicines between 2017 and 2023, many of which were antineoplastic agents and ophthalmological medicines. A small subset of the added medicines (15 medicines) were large-molecule medicines which may have substantial implications for spending on medicines. Additions to national lists did not always follow the WHO additions. The medicine that was most commonly added to national lists was rivaroxaban, which was added by 36 countries which is just over a third of the countries that updated their national lists between 2017 and 2023.

Furthermore, adding a medicine to or removing a medicine from the WHO's model list is sometimes followed by the same change being made to national lists but usually with a lag period to inclusion with a median duration of 2 years (IQR: 1 to 2 years). Possible explanations for this lag time, which varies between countries, include countries selecting medicines to include or remove before the WHO model list updates, or limited dissemination of changes to the WHO model list to the selection bodies for the national lists.[5] While changes to WHO's model list may catalyse inclusion (or removal) in national lists, countries must ensure appropriate selection of medicines for inclusion in their national lists and appropriate access. These processes may be supported by initiatives such as the WHO prequalification programme, which can facilitate national authorization of medicines,[14] and the medicine patent pool, which negotiates access-oriented voluntary licensing.[15] WHO publishes the reasons for changes to its model list in the reports of the Expert Committee on the Selection and Use of Essential Medicines. Sharing similar explanations for why a medicine is included in or excluded from national lists could lead to better decision-making globally.

The revision or creation of many national lists between 2017 and 2023 shows a high level of global engagement in the concept of essential medicines. National lists are growing in length and added medicines include anticoagulants, anti-infectives and mental health treatments. Similar to our main finding, the literature on national lists also indicates increased engagement in the concept of essential medicines since 2017. For example, we found 190 peer-reviewed publications in MEDLINE using the terms "essential medicine lists" or its synonyms in the 11 years between 2006 and 2017 (17 publications a year on average) and 346 publications published in the 5 years between 2018 and 2023 (69 publications a year). Other studies have found that countries may revise their national lists for a variety of reasons including adapting to changing health priorities, such as the increasing burden of cardiovascular disease[16] or the emergence of coronavirus disease 2019,[17] taking consideration of specific populations such as children,[18] and responding to new evidence on specific medicines. National lists may also help countries prioritize medicines for procurement and distribution.[19] Our previous study using the 2017 data found that differences in national lists were not easily explained by differences in country characteristics or health needs, suggesting that factors related to the process of compiling national lists may also be relevant;[4] our current study had similar findings.

Conclusion

With the WHO model list now 50 years old, it is an appropriate time to reflect on what is working well and what should change over the next five decades. The number of countries updating their national lists suggests that, globally, substantial resources are invested in prioritizing medicines for access. Our findings also suggest that opportunities exist to improve selection processes for national lists, perhaps by following WHO guidance on how to select medicines,[20] and for the concept of essential medicines to be adopted by the 37 countries that currently do not publish a national list. The WHO model list helps to mobilize knowledge and catalyse change, but more work is needed to ensure that knowledge translates into better health outcomes.

Appropriate medicine selection is necessary but not sufficient to promote and protect health. Countries that have regularly updated their national lists and have evidence-based selection processes do not always ensure medicine access for all people, although the initial impetus for the WHO model list was to promote access to medicines. The high costs of medicines prohibit access in some countries where certain publicly funding new treatments could more than double health spending.[21] Together with other measures, inclusion in the WHO model list has facilitated decreases in the costs of some medicines such as treatments for human immunodeficiency virus infection but these savings have not been realized for many other medicines such as newer cancer treatments.[22] Patents are supposed to promote innovations and improve access to effective treatments rather than prohibit access for most people. Mechanisms such as compulsory licensing, patent pooling and reverse engineering can be used in the future to reduce costs and promote access just as they have been used in the past.[23] Indeed, a rights-based approach to access to essential medicines should translate into action by states to ensure that medicines included in national lists are available to their populations and that listing decisions are based on health needs of the population rather than prices desired by patent holders. Higher-income countries can learn from leadership shown in countries with smaller economies, such as South Africa, which regularly updates its national list using a transparent process,[17] and encouragingly, Canada and Ireland are developing policies that could help advance the concept of essential medicines.[24–26]

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None declared.

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Table 1. **Medicines added to and removed from the *WHO Model List of Essential Medicines* and national essential medicines lists between 2017 and 2023**

Medicine	ATC code	Year of WHO addition	Year of WHO removal	No. of countries		No. (%)		No of. countries adding or removing since WHO's addition or removal	Years between WHO addition or removal and countries' addition or removal in years, median (IQR)
				Adding	Removing	Countries listing in 2017 (*n* = 137)	Countries listing in 2023 (*n* = 158)		
Added by WHO									
Abiraterone	L02BX03	2019	NA	30	0	3 (2.2)	37 (23.4)	30	2.0 (1.0 to 3.0)
Acamprosate	N07BB03	2023	NA	5	0	4 (2.9)	11 (7.0)	5	NA
Aclidinium bromide	R03BB05	2021	NA	9	0	0 (0.0)	14 (8.9)	9	4.0 (2.5 to 4.0)
Adalimumab	L04AB04	2019	NA	20	2	19 (13.9)	43 (27.2)	20	2.0 (1.0 to 3.0)
Afatinib	L01EB03	2019	NA	10	0	0 (0.0)	15 (9.5)	10	3.0 (2.0 to 4.0)
Alteplase	B01AD02	2019	NA	20	2	26 (19.0)	50 (31.6)	20	2.0 (1.0 to 3.0)
Anidulafungin	J02AX06	2021	NA	11	0	0 (0.0)	16 (10.1)	11	2.0 (2.0 to 3.0)
Ansuvimab	J06BD04	2023	NA	1	0	0 (0.0)	1 (0.6)	1	NA
Apixaban	B01AF02	2019	NA	16	0	3 (2.2)	24 (15.2)	16	3.0 (1.2 to 4.0)
Aprepitant	A04AD12	2019	NA	15	1	9 (6.6)	30 (19.0)	15	2.0 (0.2 to 2.8)
Aripiprazole	N05AX12	2023	NA	16	3	17 (12.4)	37 (23.4)	16	0.0 (0.0 to 0.0)
Arsenic trioxide	L01XX27	2019	NA	12	0	4 (2.9)	19 (12.0)	12	2.0 (2.0 to 3.0)
Atoltivimab, maftivimab and odesivimab[a]	NA	2023	NA	0	0	0 (0.0)	0 (0.0)	0	NA
Atorvastatin	C10AA05	2021	NA	22	7	69 (50.4)	96 (60.8)	22	1.0 (1.0 to 3.0)
Avibactam	J01DD52	2019	NA	9	0	0 (0.0)	10 (6.3)	9	2.0 (1.0 to 2.0)
Benserazide	N04BA02	2021	NA	10	5	36 (26.3)	48 (30.4)	10	1.0 (0.0 to 2.0)
Bisacodyl	A06AB02	2021	NA	8	5	76 (55.5)	89 (56.3)	8	1.5 (1.0 to 2.8)
Bortezomib	L01XG01	2019	NA	22	2	22 (16.1)	49 (31.0)	22	2.0 (1.0 to 2.2)
Bromocriptine	G02CB01	2023	NA	8	11	76 (55.5)	80 (50.6)	8	NA
Bumetanide	C03CA02	2021	NA	2	3	11 (8.0)	11 (7.0)	2	3.0 (2.5 to 3.5)
Buprenorphine[b]	N02AE01	2021	NA	14	5	34 (24.8)	49 (31.0)	14	2.0 (1.0 to 2.2)
Bupropion	N06AX12	2021	NA	9	5	24 (17.5)	33 (20.9)	9	2.0 (1.0 to 2.0)
Cabergoline	G02CB03	2023	NA	13	4	26 (19.0)	41 (25.9)	13	0.0 (0.0 to 0.0)
Calcipotriol	D05AX02	2021	NA	12	8	31 (22.6)	40 (25.3)	12	2.0 (2.0 to 3.0)
Calcitriol	D05AX03	2021	NA	28	0	0 (0.0)	39 (24.7)	28	2.0 (0.0 to 3.0)
Canagliflozin	A10BK02	2021	NA	7	0	0 (0.0)	9 (5.7)	7	2.0 (1.5 to 4.0)

Carbachol	S01EB02	2021	NA	5	3	10 (7.3)	10 (6.3)	5	1.0 (0.0 to 2.0)
Carbetocin	H01BB03	2019	NA	16	0	6 (4.4)	25 (15.8)	16	1.0 (0.5 to 2.0)
Carbimazole	H03BB01	2019	NA	5	7	70 (51.1)	79 (50.0)	5	0.0 (0.0 to 0.5)
Caspofungin	J02AX04	2021	NA	9	4	16 (11.7)	24 (15.2)	9	2.0 (2.0 to 3.5)
Cefiderocol	J01DI04	2021	NA	2	0	0 (0.0)	2 (1.3)	2	2.0 (2.0 to 2.0)
Ceftolozane	J01DI54	2023	NA	5	0	0 (0.0)	7 (4.4)	5	1.0 (1.0 to 1.0)
Cefuroxime	J01DC02	2019	NA	12	8	73 (53.3)	89 (56.3)	12	2.0 (0.5 to 3.0)
Certolizumab pegol	L04AB05	2019	NA	8	0	7 (5.1)	18 (11.4)	8	2.0 (1.2 to 2.8)
Cetirizine	R06AE07	2021	NA	11	11	56 (40.9)	61 (38.6)	11	2.0 (0.8 to 2.2)
Chlorothiazide	C03AA04	2021	NA	1	0	1 (0.7)	3 (1.9)	1	2.0 (2.0 to 2.0)
Chlortalidone	C03BA04	2021	NA	14	3	18 (13.1)	30 (19.0)	14	3.0 (1.2 to 3.0)
Chlortetracycline	S01AA02	2021	NA	4	1	6 (4.4)	10 (6.3)	4	2.5 (1.5 to 3.2)
Ciclesonide	R01AD13	2021	NA	5	1	10 (7.3)	19 (12.0)	5	4.0 (2.0 to 4.0)
Citalopram	N06AB04	2021	NA	11	10	26 (19)	33 (20.9)	11	1.5 (1.0 to 2.8)
Cladribine	L01BB04	2023	NA	5	4	17 (12.4)	19 (12.0)	5	0.0 (0.0 to 0.5)
Coagulation factor II	B02BD	2023	NA	21	1	7 (5.1)	41 (25.9)	21	0.0 (0.0 to 0.0)
Coagulation factor VII	B02BD05	2023	NA	15	11	35 (25.5)	44 (27.8)	15	0.0 (0.0 to 0.0)
Coagulation factors X	B02BD13	2023	NA	14	7	24 (17.5)	39 (24.7)	14	0.0 (0.0 to 0.0)
Conjugated estrogens	G03CA57	2023	NA	5	13	59 (43.1)	61 (38.6)	5	0.0 (0.0 to 0.0)
Cyclopentolate	S01FA04	2021	NA	11	8	51 (37.2)	60 (38.0)	11	1.5 (0.0 to 2.0)
Dabigatran etexilate	B01AE07	2019	NA	19	1	14 (10.2)	37 (23.4)	19	2.0 (1.0 to 2.8)
Dapagliflozin	A10BK01	2021	NA	25	0	0 (0.0)	30 (19.0)	25	3.0 (1.2 to 3.0)
Deferasirox	V03AC03	2021	NA	17	5	21 (15.3)	41 (25.9)	17	2.0 (2.0 to 3.0)
Deferiprone	V03AC02	2023	NA	5	4	14 (10.2)	20 (12.7)	5	0.0 (0.0 to 0.0)
Dengue virus vaccines	J07BX04	2019	NA	4	0	0 (0.0)	6 (3.8)	4	2.0 (1.8 to 2.2)
Diazoxide	C02DA01	2019	NA	5	5	15 (10.9)	16 (10.1)	5	2.0 (0.0 to 2.0)
Dolasetron	A04AA04	2021	NA	2	1	2 (1.5)	3 (1.9)	2	1.0 (0.5 to 1.5)
Edoxaban	B01AF03	2019	NA	7	0	0 (0.0)	10 (6.3)	7	4.0 (3.5 to 4.0)
Empagliflozin	A10BK03	2021	NA	18	0	0 (0.0)	23 (14.6)	18	2.0 (1.0 to 4.0)
Enzalutamide	L02BB04	2021	NA	17	0	0 (0.0)	22 (13.9)	17	3.0 (1.8 to 3.0)
Erlotinib	L01EB02	2019	NA	18	1	18 (13.1)	43 (27.2)	18	2.5 (2.0 to 3.2)
Escitalopram	N06AB10	2021	NA	14	6	25 (18.2)	43 (27.2)	14	1.0 (0.2 to 2.8)
Etanercept	L04AB01	2019	NA	14	5	27 (19.7)	40 (25.3)	14	3.0 (2.0 to 4.0)
Everolimus	L01EG02	2021	NA	15	2	24 (17.5)	40 (25.3)	15	2.0 (1.0 to 3.0)
Fexinidazole	P01CA03	2019	NA	5	0	0 (0.0)	7 (4.4)	5	2.0 (1.0 to 2.0)
Fexofenadine	R06AX26	2021	NA	3	9	24 (17.5)	22 (13.9)	3	2.0 (1.5 to 2.0)
Flunisolide	R01AD04	2021	NA	1	0	0 (0.0)	1 (0.6)	1	2.0 (2.0 to 2.0)
Flutamide	L02BB01	2021	NA	4	15	44 (32.1)	36 (22.8)	4	1.5 (0.8 to 2.5)
Fluticasone	R03BA05	2021	NA	19	10	58 (42.3)	82 (51.9)	19	2.0 (1.0 to 3.0)

Fluvastatin	C10AA04	2021	NA	3	12	24 (17.5)	19 (12.0)	3	2.0 (1.0 to 3.0)
Fluvoxamine	N06AB08	2021	NA	7	7	21 (15.3)	26 (16.5)	7	2.0 (1.5 to 2.5)
Gefitinib	L01EB01	2019	NA	16	0	11 (8)	29 (18.4)	16	2.0 (1.5 to 3.5)
Glatiramer acetate	L03AX13	2023	NA	4	2	18 (13.1)	24 (15.2)	4	0.0 (0.0 to 0.0)
Glecaprevir	J05AP57	2019	NA	16	0	0 (0.0)	19 (12.0)	16	2.5 (1.8 to 3.2)
Glycopyrronium bromide	R03BB06	2021	NA	22	1	14 (10.2)	43 (27.2)	22	2.0 (1.0 to 4.0)
Golimumab	L04AB06	2019	NA	16	1	5 (3.6)	25 (15.8)	16	2.0 (1.0 to 3.0)
Goserelin	L02AE03	2021	NA	15	6	47 (34.3)	65 (41.1.)	15	2.0 (1.0 to 3.0)
Granisetron	A04AA02	2021	NA	9	10	37 (27)	39 (24.7)	9	2.0 (2.0 to 3.0)
Homatropine	S01FA05	2021	NA	5	7	32 (23.4)	35 (22.2)	5	3.0 (2.0 to 3.0)
Hydromorphone	N02AA03	2021	NA	2	3	13 (9.5)	16 (10.1)	2	1.0 (0.5 to 1.5)
Ibrutinib	L01EL01	2021	NA	13	0	0 (0.0)	16 (10.1)	13	2.5 (1 to 3.2)
Indapamide	C03BA11	2021	NA	13	8	40 (29.2)	51 (32.3)	13	1.0 (1.0 to 2.0)
Indometacin	C01EB03	2021	NA	5	18	87 (63.5)	82 (52.0)	5	0.0 (0.0 to 0.5)
Infliximab	L04AB02	2019	NA	14	1	22 (16.1)	42 (26.6)	14	2.0 (1.8 to 3.2)
Insulin analogues (or insulin), long-acting	A10AE	2021	NA	10	15	115 (83.9)	116 (73.4)	10	2.5 (1.2 to 3.0)
Lenalidomide	L04AX04	2019	NA	26	1	11 (8.0)	42 (26.6)	26	2.0 (1.0 to 3.0)
Letrozole	L02BG04	2023	NA	20	6	39 (28.5)	62 (39.2)	20	0.0 (0.0 to 0.0)
Levetiracetam	N03AX14	2023	NA	29	6	31 (22.6)	63 (39.9)	29	0.0 (0.0 to 0.0)
Lisinopril	C09AA03	2019	NA	15	5	50 (36.5)	65 (41.1)	15	2.0 (1.0 to 3.0)
Lovastatin	C10AA02	2021	NA	3	10	20 (14.6)	14 (8.9)	3	4.0 (3.0 to 4.0)
Melphalan	L01AA03	2019	NA	20	9	68 (49.6)	89 (56.3)	20	2.0 (1.0 to 3.0)
Mesalazine	A07EC02	2021	NA	17	11	49 (35.8)	66 (41.8)	17	2.0 (1.5 to 3.0)
Methylergometrine	G02AB01	2021	NA	6	15	63 (46.0)	61 (38.6)	6	1.0 (1.0 to 1.8)
Micafungin	J02AX05	2021	NA	11	2	5 (3.6)	15 (9.5)	11	2.0 (2.0 to 3.0)
Mometasone	D07AC13	2021	NA	8	10	38 (27.7)	44 (27.8)	8	2.0 (2.0 to 2.0)
Naltrexone	N07BB04	2023	NA	10	5	19 (13.9)	31 (19.6)	10	0.0 (0.0 to 0.0)
Netilmicin	S01AA23	2021	NA	3	8	19 (13.9)	15 (9.5)	3	2.0 (1.0 to 2.0)
Nilutamide	L02BB02	2021	NA	1	1	4 (2.9)	7 (4.4)	1	2.0 (2.0 to 2.0)
Nivolumab	L01FF01	2019	NA	13	0	0 (0.0)	18 (11.4)	13	2.0 (1.8 to 3.0)
Octreotide	H01CB02	2023	NA	14	6	42 (30.7)	56 (35.4)	14	0.0 (0.0 to 0.0)
Olanzapine	N05AH03	2023	NA	22	8	64 (46.7)	88 (55.7)	22	0.0 (0.0 to 0.0)
Oxycodone[b]	N02AA05	2021	NA	19	2	22 (16.1)	50 (31.6)	19	3.0 (1.0 to 3.0)
Oxytetracycline	S01AA04	2021	NA	6	6	29 (21.2)	35 (22.2)	6	2.0 (1.0 to 2.0)
Paliperidone	N05AX13	2021	NA	15	1	8 (5.8)	25 (15.8)	15	2.0 (1.0 to 3.0)
Palonosetron	A04AA05	2021	NA	5	1	11 (8)	18 (11.4)	5	1.0 (1.0 to 2.0)
Paroxetine	N06AB05	2021	NA	12	8	37 (27)	50 (31.6)	12	1.5 (0.2 to 2.0)
Pegaspargase	L01XX24	2019	NA	9	0	4 (2.9)	16 (10.1)	9	2.5 (2.0 to 3.0)

Pegfilgrastim	L03AA13	2023	NA	5	2	15 (10.9)	21 (13.3)	5	1.0 (1.0 to 1.0)
Pembrolizumab	L01FF02	2019	NA	13	0	0 (0.0)	17 (10.8)	13	2.0 (1.0 to 3.0)
Perindopril	C09AA04	2023	NA	11	8	28 (20.4)	39 (24.7)	11	0.0 (0.0 to 0.0)
Pibrentasvir	NA	2019	NA	16	0	0 (0.0)	19 (12.0)	16	2.5 (1.8 to 3.2)
Plazomicin	J01GB14	2019	NA	3	0	0 (0.0)	4 (2.5)	3	2.0 (1.5 to 2.0)
Pravastatin	C10AA03	2021	NA	5	10	23 (16.8)	23 (14.6)	5	1.0 (0.0 to 2.0)
Prednisone	H02AB07	2021	NA	2	30	87 (63.5)	52 (32.9)	2	2.5 (2.2 to 2.8)
Pretomanid	J04AK08	2023	NA	2	0	0 (0.0)	3 (1.9)	2	NA
Quetiapine	N05AH04	2023	NA	18	5	34 (24.8)	56 (35.4)	18	0.0 (0.0 to 0.0)
Ramipril	C09AA05	2023	NA	10	11	40 (29.2)	44 (27.8)	10	0.0 (0.0 to 0.0)
Rasburicase	V03AF07	2021	NA	6	1	4 (2.9)	12 (7.6)	6	2.0 (1.2 to 2.0)
Ravidasvir	J05AP13	2023	NA	1	0	0 (0.0)	1 (0.6)	1	0.0 (0.0 to 0.0)
Rivaroxaban	B01AF01	2019	NA	36	1	10 (7.3)	51 (32.3)	36	3.0 (1.0 to 3.0)
Salmeterol	R03AC12	2021	NA	16	15	56 (40.9)	68 (43.0)	16	2.0 (1.0 to 2.0)
Sertraline	N06AB06	2021	NA	15	8	55 (40.1)	70 (44.3)	15	3.0 (2.0 to 3.0)
Sevoflurane	N01AB08	2023	NA	28	5	47 (34.3)	80 (50.6)	28	0.0 (0.0 to 0.0)
Sumatriptan	N02CC01	2021	NA	9	11	40 (29.2)	46 (29.1)	9	2.0 (0.0 to 3.0)
Tacalcitol	D05AX04	2021	NA	1	0	4 (2.9)	5 (3.2)	1	2.0 (2.0 to 2.0)
Tacrolimus	L04AD02	2021	NA	18	3	51 (37.2)	77 (48.7)	18	2.0 (1.0 to 3.0)
Tedizolid	J01XX11	2023	NA	1	0	0 (0.0)	2 (1.3)	1	NA
Telmisartan	C09CA07	2019	NA	21	5	22 (16.1)	47 (29.7)	21	2.0 (1.0 to 3.0)
Terbutaline	R03AC03	2021	NA	9	1	26 (19.0)	37 (23.4)	9	2.0 (1.0 to 3.0)
Thalidomide	L04AX02	2019	NA	15	3	25 (18.2)	46 (29.1)	15	2.0 (1.0 to 3.0)
Thiamazole	H03BB02	2019	NA	15	5	39 (28.5)	56 (35.4)	15	2.0 (1.5 to 3.0)
Thiopental	N01AF03	2021	NA	10	15	109 (79.6)	120 (75.9)	10	0.0 (0.0 to 2.2)
Tinidazole	P01AB02	2021	NA	7	8	51 (37.2)	54 (34.2)	7	1.5 (1.0 to 2.0)
Tiotropium bromide	R03BB04	2019	NA	19	3	26 (19.0)	54 (34.2)	19	2.0 (1.8 to 3.0)
Tobramycin	S01AA12	2021	NA	14	6	56 (40.9)	74 (46.8)	14	2.0 (2.0 to 3.0)
Torasemide	C03CA04	2021	NA	9	2	7 (5.1)	16 (10.1)	9	2.0 (1.0 to 3.0)
Triamcinolone	H02AB08	2023	NA	7	12	67 (48.9)	73 (46.2)	7	NA
Trihexyphenidyl	N04AA01	2021	NA	7	11	86 (62.8)	92 (58.2)	7	2.0 (0.5 to 2.8)
Triptorelin	L02AE04	2021	NA	13	6	30 (21.9)	46 (29.1)	13	2.0 (2.0 to 3.0)
Tropisetron	A04AA03	2021	NA	2	5	12 (8.8)	9 (5.7)	2	1.0 (0.5 to 1.5)
Umeclidinium bromide	R03BB07	2021	NA	13	0	0 (0.0)	19 (12.0)	13	3.5 (2.8 to 4.0)
Vaborbactam	J01DH52	2019	NA	6	0	0 (0.0)	7 (4.4)	6	1.5 (1.0 to 2.0)
Valaciclovir	J05AB11	2021	NA	11	6	34 (24.8)	46 (29.1)	11	1.5 (1.0 to 2.0)
Varenicline	N07BA03	2021	NA	8	2	9 (6.6)	16 (10.1)	8	2.0 (1.0 to 2.5)
Vilanterol	R03AK10	2021	NA	15	0	2 (1.5)	20 (12.7)	15	3.0 (2.0 to 4.0)
Zuclopenthixol	N05AF05	2023	NA	5	9	39 (28.5)	42 (26.6)	5	0.0 (0.0 to 0.0)
Removed by WHO									

Aztreonam	J01DF01	NA	2019	3	5	13 (9.5)	16 (10.1)	5	0.0 (0.0 to 2.0)
Capreomycin	J04AB30	NA	2019	13	11	44 (32.1)	56 (35.4)	11	2.0 (1.0 to 2.0)
Cefepime	J01DE01	NA	2019	18	3	26 (19.0)	45 (28.5)	3	4.0 (4.0 to 4.0)
Ceftaroline	J01DI02	NA	2019	7	0	1 (0.7)	8 (5.1)	0	NA
Daptomycin	J01XX09	NA	2019	5	1	3 (2.2)	9 (5.7)	1	3.0 (3.0 to 3.0)
Dasabuvir	J05AP09	NA	2023	12	1	4 (2.9)	18 (11.4)	1	0.0 (0.0 to 0.0)
Ombitasvir, paritaprevir and ritonavir[c]	J05AP53	NA	2023	12	1	4 (2.9)	17 (10.8)	1	0.0 (0.0 to 0.0)
Peginterferon alfa-2a	L03AB11	NA	2023	17	10	39 (28.5)	56 (35.4)	10	0.5 (0.2 to 0.8)
Peginterferon alfa-2b	L03AB10	NA	2023	15	12	30 (21.9)	39 (24.7)	12	0.5 (0.2 to 0.8)
Simeprevir	J05AP05	NA	2019	5	3	5 (3.6)	9 (5.7)	3	3.0 (2.5 to 3.5)
Tigecycline	J01AA12	NA	2019	16	1	8 (5.8)	26 (16.5)	1	0.0 (0.0 to 0.0)
Kanamycin[d]	J01GB04/ S01AA24	2021	2019	9	19	60 (43.8)	60 (38.0)	NA	NA

ATC: Anatomical Therapeutic Chemical; IQR: interquartile range; NA: not applicable; WHO: World Health Organization.

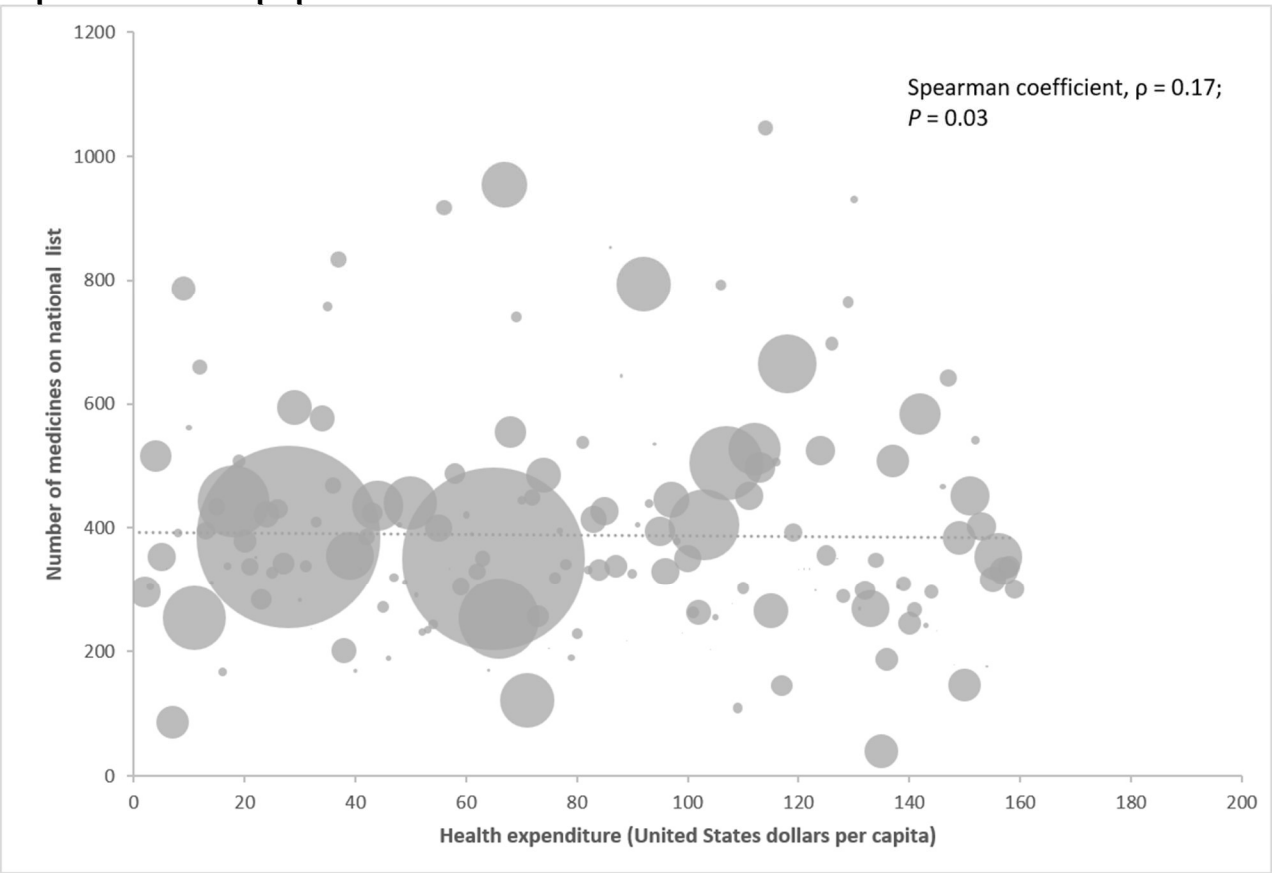
[a] This fixed-dose combination was added to the WHO model list in 2023. Neither this combination nor the individual medicines composing the combination have yet been added to any national list. Thus, we have left the combination rather than separating into its individual medicines.

[b] While this medicine was listed as a therapeutic alternative before 2017, subsequent WHO model lists more clearly indicated the therapeutic alternatives and that they should be included in national lists.

[c] This fixed-dose combination was added to the WHO model list in 2023. Ombitasvir and paritaprevir were listed in national essential medicines lists only in this combination, and were never listed in their individual forms. Thus, we have left the combination rather than separating into its individual medicines

[d] Topical kanamycin for treatment of ocular infections (ATC code S01AA24) was added to the WHO model list as a therapeutic alternative to gentamicin in 2021. Kanamycin injection for treatment of multidrug-resistant tuberculosis (ATC code J01GB04) was removed from the WHO model list in 2019 for this indication.

Fig. 1. **Number of medicines on national essential medicines lists, by health expenditure and population size**



Note: Bubble size indicates population size.

Sources: World Health Organization, 2024;[11] United Nations, 2022.[12]