Relation between opioid consumption and inclusion of opioids in 137 national essential medicines lists

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ABSTRACT

Introduction Opioids are deemed essential medicines by the World Health Organization (WHO). However, many countries have inadequate access to them. Whether including opioids in national essential medicines lists (EMLs) influences national opioid consumption has not been evaluated.

Methods We conducted a cross-sectional study to determine whether the listing of opioids in national EMLs was associated with consumption. We quantified the numbers and types of all opioids included in 137 national EMLs, for comparison with opioids in the WHO’s Model List of Essential Medicines. Using the International Narcotics Control Board (INCB) consumption statistics for 2015–2017, we assessed the relation between annual mean opioid consumption (mg/person) and the numbers of opioids included in EMLs, controlling for region, population, healthcare expenditure, life expectancy, gross domestic product, human development and corruption.

Results Five opioids were included in the 20th edition of the WHO’s Model List of Essential Medicines: codeine, fentanyl, loperamide, methadone and morphine. On average, countries’ lists included significantly (p<0.05) more opioids than the WHO’s Model List. However, there were wide variations in the numbers (median 6 opioids; IQR: 5–9) and types (n=33) of opioids included in national EMLs. Morphine (95%), fentanyl (83%) and codeine (69%) were the most commonly included opioids. Most national EMLs were out of date (median publication date: 2011, IQR: 2009–2013). After adjusting for country characteristics, there was no relation between mean opioid consumption and the number of opioids in EMLs.

Conclusions Including opioids in national EMLs was not associated with consumption. National EMLs should be regularly updated to reflect the availability of opioids and the populations’ needs for managing pain.

Key questions

What is already known?
► WHO deems opioids as essential for managing pain, palliative care, anaesthesia and opioid dependence.
► WHO encourages countries to adopt and adapt the WHO’s Model List of Essential Medicines to identify national essential medicines lists (EMLs) to meet the priority health needs of their populations.
► Studies have not explored the relation between listing opioids in EMLs and consumption.

What are the new findings?
► National EMLs included a median of 6 (IQR: 5–9) opioids.
► Lists included significantly more opioids than the five opioids (ie, codeine, fentanyl, loperamide, methadone and morphine) in the WHO’s Model List of Essential Medicines.
► Morphine, fentanyl, codeine, pethidine and tramadol were the most commonly included opioids in lists.
► After adjusting for country characteristics, there was no relation between the number of opioids in EMLs and mean opioid consumption.

What do the new findings imply?
► Simply putting an opioid in an EML may not increase supply or change prescribing habits, which questions the usefulness of current EMLs in extending the accessibility of the most important medicines such as opioids.
► Revisions of current lists to reflect the availability of opioids and the populations’ needs for managing pain, palliative care, anaesthesia and opioid dependence would be timely.

INTRODUCTION

Opioids are essential in managing pain, and other symptoms frequent in palliative care, opioid dependence and diarrhoeal diseases. Since the publication of its first list in 1977, WHO has included opioids in its Model List of Essential Medicines. Medicines selected by the WHO for inclusion in its Model List are of utmost importance, and are basic, indispensable and necessary for the health needs of the population. WHO encourages governments to adopt and adapt the WHO’s Model List to meet the needs of their populations. Currently, 137 countries (70% of 195 countries) serving more than 5 billion people have essential medicines lists (EMLs). Countries that implement the WHO’s EML policies have improved the quality of usage...
of medicines. However, studies have highlighted considerable variation in the numbers and types of medicines included in EMLs. Researchers have evaluated the inclusion of medicines for neuropathic pain in national EMLs. However, this analysis only included four opioids (ie, tramadol, morphine, methadone and oxy-codone) and focused on low-income and middle-income countries. It is now recognised that adoption of a list of essential medicines could be beneficial in high-income countries, to reduce suboptimal prescribing and improve the affordability of essential medicines. However, the numbers and types of all opioids included by all countries with national EMLs have not been investigated. Nor is it known how the number of opioids included in a list is related to consumption.

The central aim of this study was to determine whether the listing of opioids in national EMLs is associated with consumption, as a proxy measure of accessibility, where consumption refers to the medical use of opioids and excludes recreational use. We also quantified the numbers and types of all opioids included by all countries with national EMLs, for comparison with the WHO’s Model List of Essential Medicines.

METHODS

Study design and data sources

We designed and conducted a cross-sectional observational study following the publication of the Global Essential Medicines (GEM) database and on receiving updated data from the International Narcotics Control Board (INCB) in August 2019. The protocol for our study is openly available on the Open Science Framework (OSF: https://osf.io/385hx/).

The International Narcotics Control Board (INCB), an independent body of the United Nations (UN), monitors implementation of international drug control conventions, including the Single Convention on Narcotic Drugs of 1961, which requires governments to report annual statistics on narcotic consumption relating to controlled drugs. Consumption refers to the total amount of a narcotic that is distributed for medical purposes at the retail level (ie, to institutions and programmes that are licensed to dispense to a patient). We received data from 2015 to 2017 in kg and removed 27 non-opioid substances (eg, cannabis, coca leaf and cocaine) to create a dataset of all opioids consumed. The included and excluded substances are listed in online supplemental box S1. We calculated a 3-year annual mean for each country with an EML. We adjusted for population size using 2016 data from the WHO Global Health Observatory to create a rate (ie, mean consumption in mg per person), see online supplemental box S2 for a sample calculation.

The GEM database was developed by Persaud et al in June 2017, by extracting all medicines listed by all countries with a national EML from the WHO’s repository, as previously described, and all medicines listed in the 20th edition of the WHO’s Model List of Essential Medicines, which was the most up to date list published at the time the GEM database was created. In June 2019, WHO published the 21st edition of their Model List but there were no opioids added to the list, and thus, we used the 20th edition to be consistent with the GEM database. The medicines included in the database are coded using the Anatomical Therapeutic Classification (ATC) index. Two authors (GCR and JKA) independently searched the ATC index to create a list of opioids, compared their lists, discussed discrepancies and agreed on a master list of ATC codes for opioids; see online supplemental table S1. We used the ATC codes and medicine names in the master list to search for opioids in the GEM database for every country (n=137) with an EML.

Opioids included in EMLs

We identified the numbers and types of opioids included in the 20th edition of the WHO’s Model List of Essential Medicines, which was current when we began this study. We summed the number of opioids and identified the types of opioids for all countries with a national EML (n=137, 70% of 195 countries as defined by the UN). We calculated the median and IQR for the number of opioids in EMLs. We calculated the percentage of opioids listed as a total of all included medicines, and compared countries’ lists with the WHO’s Model list using a one-sample z-test and a significance level of 0.05. For each country, we calculated the numbers of opioids that were the same as or different from the WHO’s Model List to create percentages of similarities and differences.

Relation between opioid consumption and listing opioids in EMLs

We extracted geographical region, population, healthcare expenditure per capita (US$), life expectancy at birth (in years) for all sexes, gross domestic product (GDP) per capita, the human development index and the corruption perception scores for each country with an EML from web pages outlined in online supplemental table S2. The assumptions for untransformed linear regression were not met. Thus, we used a square root transformation of the dependent variable (ie, opioid consumption in mg/person), which improved the model. We conducted two multivariable analyses. In the first, we adjusted for GDP per capita and healthcare expenditure per capita, as these variables had the least amount of missing data (n=133). In the second analysis we adjusted for all country characteristics. We conducted a sensitivity analysis by removing extreme outliers.

Statistical software and data access

We used Stata V.16 for all statistical analyses and pandas and plotly modules in Jupyter Notebooks with Python v3 for choropleth maps. Our protocol, study materials, data and statistical code are all openly available on the OSF (https://osf.io/385hx/) and GitHub (https://github.com/georgiarichards/opioid_emls_maps). We used The Strengthening the Reporting of Observational Studies in
Epidemiology (STROBE) reporting guidelines to write our manuscript; see the online supplemental 1 for the completed checklist.

Protocol deviations
We used INCB data from 2015 to 2017 instead of 2014 to 2016, as we obtained the most up-to-date data before we started the analysis (August 2019). We could not convert consumption from volume (ie, kg) to morphine equivalents, because potency ratios are not available for all types of opioids included in our analysis. We did not conduct regression analyses for individual types of opioids as there were missing data; for example, only 73 countries (53%) with EMLs reported consumption data for oxycodone; see online supplemental table S3.

Patient and public involvement
We involved three patients who have chronic pain and experience of taking opioids and other medicines for pain at the analysis phase of our research. Lead author (GCR) presented the preliminary findings to the patients during a formal face-to-face patient and public involvement meeting in December 2019. Patients provided suggestions for final analyses, the presentation of results, and the dissemination plans for our research. Preliminary findings were also presented to stakeholders at the inaugural Global Essential Medicines Meeting in November 2019 in Toronto, Canada, which included members of the WHO’s Expert Committee on the Selection and Use of Essential Medicines. All stakeholders will be involved in the dissemination of our research.

RESULTS
Opioids listed in the WHO’s Model List of Essential Medicines
The 20th edition of the WHO’s Model List of Essential Medicines included five opioids: codeine, fentanyl, loperamide, methadone and morphine; see online supplemental table S4. The included opioids account for 1.4% of all medicines listed in the WHO’s Model List.

Opioids listed in national EMLs
EMLs included a median of six opioids (IQR: 5–9). Slovakia included the most opioids (n=19) while Cambodia did not include any (see figure 1 and online supplemental table S5). There were 33 different opioids included in national EMLs (see figure 2 and online supplemental table S6). The most commonly included opioid was morphine (95%), followed by fentanyl (83%), codeine (69%), pethidine (65%) and tramadol (62%) (see figure 2). The median publication date for EMLs was 2011 (IQR: 2009–2013; range: 2001–2017); (see online supplemental table S5).

Comparison of national EMLs with the WHO’s Model List
Countries with EMLs included significantly more opioids (z=6.33, p<0.05) as a percentage of all medicines than the WHO’s Model List. Ninety-five per cent of countries included morphine, 83% listed fentanyl, 69% codeine, 61% loperamide and 41% methadone (see figure 3). Most countries (98.5%) included at least one opioid recommended by the WHO, except for Cambodia, which listed no opioids, and Somalia which only listed pethidine. Eighteen per cent of countries (25 of 137) included all five opioids (ie, codeine, fentanyl, loperamide, methadone and morphine) included in WHO’s Model list (see online supplemental figure S1). There were also a number of opioids included in national EMLs that were not included in the WHO Model Lists (see online supplemental figure S2).
Relation between consumption and the number of opioids in EMLs

Countries with EMLs consumed a median of 2 mg/day (IQR: 0.13–6.8 mg/day) of opioids between 2015 and 2017. There was a wide range in consumption (range: 0–97.9 mg/day) with most countries (93%, 128 of 137) consuming less than 20 mg/person of opioids, and 17% of countries (23 of 137) reporting no opioid consumption. Countries that did not report consumption included a median of 5 opioids (IQR: 3–7; range: 0–12 opioids) in their national EML. In the univariable analysis, there was a positive and significant association between mean opioid consumption and the number of opioids listed in national EMLs (unadjusted coefficient: 0.172, 95% CI 0.086 to 0.258, p<0.0001, table 1) but not after adjusting for GDP and healthcare expenditure (adjusted coefficient: 0.045, 95% CI −0.022 to 0.111, p=0.187, table 1) or all country characteristics as summarised in online supplemental table S7 (coefficient: 0.0109, 95% CI −0.0087 to 0.0305, p=0.271, table 1). In a sensitivity

Figure 2  Types of opioids (n=33) included in 137 national essential medicines lists ordered from most common to least.

Figure 3  The five opioids in the WHO’s Model List of Essential Medicines and the number of countries that included the five opioids in their national essential medicines lists.
Table 1  Regression models for the relation between the square rooted annual mean opioid consumption and the listing of opioids in national essential medicines lists (EMLs)

|                                      | Univariate (n=137) |                  |                  | Multivariable* (n=133) |                  |                  | Multivariable (n=117) |                  |                  |
|--------------------------------------|--------------------|------------------|------------------|------------------------|------------------|------------------|------------------------|------------------|------------------|
|                                      | Coefficient | 95% CI   | P value | Coefficient | 95% CI   | P value | Coefficient | 95% CI   | P value |
| Consumption versus number of opioids in EMLs | 0.17     | 0.09 to 0.6 | 0 | 0.05       | −0.02 to 0.11 | 0.19 | 0.01       | −0.009 to 0.03 | 0.27 |
| GDP/100 per capita                     | 0.006    | 0.003 to 0.009 | 0 | 0.0005     | −0.0012 to 0.0013 | 0.93 | 0.0004     | 0.0002 to 0.0005 | 0   |
| Healthcare expenditure per capita      | 0.0001   | 0.0007 to 0.002 | 0 | 0.0004     | 0.0002 to 0.0005 | 0   | 0.0004     | 0.0002 to 0.0005 | 0   |
| Population                            | −1.35e-10 | −5.05e-10 to 2.35e-10 | 0.47 | −0.009     | −0.03 to 0.01  | 0.38 | 1.33       | 0.012 to 2.64   | 0.48 |
| Life expectancy                       |          |                  |      |            |                  |      |            |                  |      |
| Human development index               | 1.33     | 0.012 to 2.64   | 0.48 |            |                  |      |            |                  |      |
| Correlation perception score           | 0.007    | 0.0007 to 0.01  | 0.03 |            |                  |      |            |                  |      |
| Region (Africa)                       |          |                  |      |            |                  |      |            |                  |      |
| America                               | −0.065   | −0.3 to 0.17    | 0.59 |            |                  |      |            |                  |      |
| Asia                                  | 0.12     | −0.09 to 0.33   | 0.27 |            |                  |      |            |                  |      |
| Europe                                | 0.32     | 0.04 to 0.59    | 0.03 |            |                  |      |            |                  |      |
| Oceania                               | 0.16     | −0.3 to 0.6     | 0.48 |            |                  |      |            |                  |      |

The assumptions for untransformed linear regression were not met. Thus, we used a square root transformation of the dependent variable (ie, opioid consumption in mg/person), which improved the model.

*we conducted this multivariable analysis first as it had the least amount of missing data and the variables had the strongest predictors of opioid consumption.

GDP, gross domestic product.
analysis, removing the highest income country Sweden, the relation did not change. Figure 4 illustrates the relation between opioid consumption and the number of opioids included in EMLs before transformation; online supplemental figure S3 illustrates the relation after the transformation.

DISCUSSION

After adjusting for country characteristics, the number of opioids included in EMLs was not associated with the consumption of opioids. There are wide variations in the numbers and types of opioids included in national EMLs. Countries included significantly more opioids than the WHO Model List of Essential Medicines, which included five opioids: morphine for anaesthesia; codeine, fentanyl, methadone and morphine for pain and palliative care; loperamide for diarrhoeal symptoms; and methadone for opioid use disorders. In national EMLs, morphine, fentanyl and codeine were the most common opioids included.

The purpose of EMLs, as originally stated by WHO in 1977, was to improve health, reduce costs of medicines, and extend the accessibility of the most necessary medicines to populations whose basic health needs could not be met by the existing supply system. The absence of a relation between the number of opioids in EMLs and consumption questions the usefulness of current EMLs in enabling access ‘at all times, in adequate amounts, and in the proper dosage forms’, as originally stated. However, most lists were out of date and most countries had low or no consumption of opioids. There may be other factors which influence this relation, such as cost implications imposed by EMLs, patchy implementation of lists, pharmaceutical interests that push more medicines into EMLs and restraints in the healthcare system on where and how medicines are prescribed, and by whom. However, these factors have not been explored in relation to opioids. Thus, future research should evaluate the function of EMLs in extending the accessibility of essential medicines like opioids in practice.

After the development of the first Model List of Essential Medicines, WHO encouraged countries to select medicines that meet the health priorities of their populations. Therefore, variations between countries is expected. However, including 19 different opioids, all with complex pharmacology, as found in Slovakia’s EML, or not including any opioids as found in Cambodia’s EML, may not adequately reflect differences in the health needs of those populations. Importantly, Cambodia has experienced recent outbreaks of HIV due to unsafe use of recreational opioids, and is a major transit route for exporting heroin, which may impact policies, access to pharmaceutical opioids, and health services in these regions. Future research could explore reasons for wide variations in the numbers and types of opioids included in national EMLs, and the reasons for adding or removing opioids in individual countries and regions.

Many advantages to using a central list of essential medicines have been identified. These include a reduction in the number of pharmaceutical products to be purchased, stored, analysed and distributed; an improvement in the quality of medicine utilisation, management, information and monitoring; stimulation of local

Figure 4 Scatter plot of the relation between annual mean opioid consumption (mg/person) for 2015–2017 and the number of opioids included in national essential medicines lists (EMLs) for 137 countries. Each country is represented by a symbol for its geographical region. After adjusting for country characteristics, there was no relation between consumption and the number of opioids in EMLs (coefficient: 0.0109, 95% CI: −0.0087 to 0.0305, p=0.271).

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pharmaceutical companies; assistance to low-income and middle-income countries in urgent need of high-priority medicine programmes to extend their primary healthcare provisions. WHO encourages countries to make the selection of essential medicines to be a continuing process that takes into account changing public health priorities, epidemiological conditions, progress in pharmacological and pharmacovigilance systems. We found that many lists were a number of years out of date based on the available information. Thus, revision of current EMLs to reflect such changes would be timely.

Limitations
The INCB and GEM databases do not specify formulations or dosage, and it is not possible to elucidate the clinical use of opioids consumed or included in EMLs. Thus, we recognise that medicines included in EMLs indicate nominal availability and thus caution is warranted when interpreting medicines on or absent from EMLs. Many high-income countries who consume most of the world’s opioids do not have EMLs, and therefore our regression model is not generalisable to all countries. Although our regression model was adjusted for a number of country characteristics, it is possible we may have missed some other important confounders. Consumption statistics are not reported to the INCB for opioids that are not regulated as internationally controlled substances (eg, tramadol and buprenorphine). Data reported to the INCB may also be late, unreported, or submitted inaccurately, as previously described. The effects of different types of opioids vary by weight, which morphine equivalent conversion would account for, if accurate conversion were possible. We measured consumption using weight in mg adjusted for country population, as conversion factors for morphine equivalents, and defined daily doses (DDDs) are not available for all opioid substances included in our analysis. Thus, our findings may be less comparable to most previous research on opioid consumption that uses DDDs.

CONCLUSIONS
The number of opioids in lists was not associated with consumption, which questions the usefulness of current EMLs. The numbers and types of opioids included in 137 national EMLs differ from the WHO’s Model List and vary between countries. Governments should consider updating their lists to reflect national availability of opioids and their population’s needs for managing pain, symptoms frequent in palliative care, opioid dependence and diarrhoeal diseases.

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Contributors GCR devised the research question, designed the methods, wrote the protocol, conducted data screening, data cleaning and management, analysed the data, conducted the literature review and wrote the original manuscript. JKA conducted secondary data screening for the master list of opioids, reviewed preliminary findings, critically revised the manuscript and provided supervisory support. CH, KR and NP reviewed the protocol and preliminary findings, critically revised the manuscript and provided supervisory support. NP provided access to the Global Essential Medicines Database and was the catalyst for conducting this study. CK provided statistical advice, reviewed the statistical model and preliminary findings and critically revised the manuscript. All authors read, reviewed and approved the final manuscript.

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Patient and public involvement statement We involved three patients who have chronic pain and experience of taking opioids and other medicines for pain at the analysis phase of our research. Lead author (GCR) presented the preliminary findings to the patients during a formal face-to-face PP patient and public involvement meeting in December 2019. Patients provided suggestions for final analyses, the presentation of results, and the dissemination plans for our research. Preliminary findings were also presented to stakeholders at the inaugural Global Essential Medicines Global Essential Medicines Meeting in November 2019 in Toronto, Canada, which included members of the WHO’s Expert Committee on the Selection and Use of Essential Medicines. All stakeholders will be involved in the dissemination of our research.

Patient consent for publication Not required.

Ethics approval Not required

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Data availability statement Data are available in a public, open access repository. Our protocol, study materials, data and statistical code are all openly available on the Open Science Framework (https://osf.io/385hx/) and GitHub (https://github.com/georgiarichards/opioid_emls_maps).

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REFERENCES
1 WHO. 20th essential medicines list, 2017. Available: https://www.who.int/medicines/news/2017/20th_essential_med-list/en/ LB - HW7p
2 WHO Expert Committee on the Selection of Essential Drugs & World Health Organization. The selection of essential drugs: report of a WHO expert committee [meeting held in Geneva from 17 to 21
October 1977, 1977. Available: https://apps.who.int/iris/handle/10665/41272

3 Persaud N. Essential medicines and the challenges in the evidence-based manifesto. BMJ Evid Based Med 2018;23:123–4.

4 Holloway KA, Henry D. Who essential medicines policies and use in developing and transitional countries: an analysis of reported policy implementation and medicines use surveys. PLoS Med 2014;11:e1001724.

5 Persaud N, Jiang M, Shaikh R, et al. Comparison of essential medicines Lists in 137 countries. Bull World Health Organ 2019;97:394–404.

6 Kamerman PR, Wadley AL, Davis KD, et al. World Health organization essential medicines Lists: where are the drugs to treat neuropathic pain? Pain 2015;156:793–7.

7 Persaud N, Ahmad H. Canadian list of essential medicines: potential and uncertainties. Can Fam Physician 2017;63:266–8.

8 Hogerzeil HV. The concept of essential medicines: lessons for rich countries. BMJ 2004;329:1169–72.

9 Persaud N, Jiang M, Shaikh R, et al. Global essential medicines database. Figshare 2019.

10 Thomas J. Availability of narcotic drugs for medical use. Int. Narc. Control Board 2019.

11 Richards GC, Aronson JK, Heneghan C, et al. Opioid consumption and the inclusion of opioids in 137 national essential medicines lists., 2020. Open Science Framework. DOI: 10.17605/OSF.IO/385HX. Available: https://osf.io/385hx/[Accessed 09 Sep 2020].

12 INCB. Mandate-functions. Int. Narc. Control Board 2019.

13 WHO. Global health Observatory data Repository. World Heal. Stat 2019.

14 WHO. Who model Lists of essential medicines, 2019. Available: http://www.who.int/medicines/publications/essentialmedicines/en/ [Accessed 13 Feb 2020].

15 United Nations. Member states, 2019. Available: https://www.un.org/en/member-states/ [Accessed 13 Feb 2020].

16 StataCorp. Stata statistical software 2019.

17 De Lima L, Pastrana T, Radbruch L, et al. Cross-Sectional pilot study to monitor the availability, dispensed prices, and affordability of opioids around the globe. J Pain Symptom Manage 2014;48:649–59.

18 Li DG, Najaftzadeh M, Kesselheim AS, et al. Spending on world Health organization essential medicines in Medicare Part D, 2011-15: retrospective cost analysis. BMJ 2019;366:l4257.

19 Hill AM, Barber MJ, Gotham D. Estimated costs of production and potential prices for the who essential medicines list. BMJ Glob Health 2018;3:e000571.

20 Faruqui N, Martinik A, Sharma A, et al. Evaluating access to essential medicines for treating childhood cancers: a medicines availability, price and affordability study in New Delhi, India. BMJ Glob Health 2019;4:e001379.

21 Droit B, O’Neill KP, Mathai M, et al. Poor availability of essential medicines for women and children threatens progress towards sustainable development goal 3 in Africa. BMJ Glob Health 2019;4:e001306.

22 Gokhale RH, Galang RR, Pitman JP, et al. A tale of 2 HIV outbreaks caused by unsafe injections in Cambodia and the United States, 2014–2015. Am J Infect Control 2017;45:106–7.

23 Chalk P. Southeast Asia and the Golden Triangle’s Heroin Trade: Threat and Response. Studies in Conflict & Terrorism 2000;23:89–106.

24 Berterame S, Erthal J, Thomas J, et al. Use of and barriers to access to opioid analgesics: a worldwide, regional, and national study. The Lancet 2016;387:1644–56.

25 Berterame S, Erthal J, Thomas J, et al. Use of and barriers to access to opioid analgesics: a worldwide, regional, and national study. Lancet 2016;387:1644–56.

26 Gilson AM, Maurer MA, Ryan KM, et al. Using a morphine equivalence metric to quantify opioid consumption: examining the capacity to provide effective treatment of debilitating pain at the global, regional, and country levels. J Pain Symptom Manage 2013;45:681–700.
**Supplement 1: Additional tables and figures**

**Box S1:** Substances included and excluded from the International Narcotic Control Board (INCB) data on narcotic consumption, in alphabetical order.

**Opioids included** in the opioid consumption calculation:

| Substance                                      |   |
|------------------------------------------------|---|
| (+)-cis-3-methylfental                          | 35. Bezitramide |
| 3-Acetylmorphine                                | 36. Butyrfentanyl |
| 3-Methylfentanyl                                | 37. Carfentanil |
| 3-Methylthiofentanyl                            | 38. Carfentanil |
| 3-Monoacetylmorphine                            | 39. Clonitazene |
| 4-Fluoroisobutyrfentanyl                        | 40. Codeine |
| 6-Acetylmorphine                                | 41. Codeine-6GLUC |
| 6-Monoacetylmorphine                            | 42. Codeine-6-glucuronide |
| Acetorphine                                     | 43. Codeine-Methyl |
| Acetyl-alpha-methylfentanyl                     | 44. Codeine-N-oxide |
| Acetylhydrocodeine                              | 45. Codoxime |
| Acetylfentanyl                                  | 46. Conc. of poppy straw (C) ACA |
| Acetylmethadol                                  | 47. Conc. of poppy straw (C) AMA |
| Acetylmorphine                                  | 48. Conc. of poppy straw (C) AOA |
| Acrylfentanyl                                   | 49. Conc. of poppy straw (C) ATA |
| AH-7921                                         | 50. Conc. of poppy straw (C) GW |
| Alfentanil                                      | 51. Conc. of poppy straw (M) ACA |
| Allylprodine                                    | 52. Conc. of poppy straw (M) AMA |
| Alphacetylmethadol                              | 53. Conc. of poppy straw (M) AOA |
| Alphameprodine                                  | 54. Conc. of poppy straw (M) ATA |
| Alphamethadol                                   | 55. Conc. of poppy straw (M) GW |
| alpha-Methylfentanyl                            | 56. Conc. of poppy straw (N) GW |
| alpha-Methylthiofentanyl                        | 57. Conc. of poppy straw (O) |
| Alphaprodine                                    | 58. Conc. of poppy straw (O) ACA |
| Anileridine                                     | 59. Conc. of poppy straw (O) AMA |
| Benzethidine                                    | 60. Conc. of poppy straw (O) AOA |
| Benzoylmorphine                                 | 61. Conc. of poppy straw (O) ATA |
| Benzylmorphine                                  | 62. Conc. of poppy straw (O) GW |
| Betacetylmethadol                               | 63. Conc. of poppy straw (O)-AOA |
| beta-Hydroxy-3-methyl fentanyl                  | 64. Conc. of poppy straw (T) |
| beta-Hydroxyfentanyl                            | 65. Conc. of poppy straw (T) ACA |
| Betameprodine                                   | 66. Conc. of poppy straw (T) AMA |
| Betamethadol                                    | 67. Conc. of poppy straw (T) AOA |
| Betaproline                                     | 68. Conc. of poppy straw (T) ATA |
|   |   |   |
|---|---|---|
| 69. | Conc. of poppy straw (T) GW | 103. | Etorphine-3metheth |
| 70. | Conc. of poppy straw (T)-ATA | 104. | Etoxeridine |
| 71. | Conc. of poppy straw (total) anhydrous codeine alkaloid | 105. | Fentanyl |
| 72. | Conc. of poppy straw (total) anhydrous morphine alkaloid | 106. | Furanylketone |
| 73. | Conc. of poppy straw (total) anhydrous oripavine alkaloid | 107. | Furethidine |
| 74. | Conc. of poppy straw (total) anhydro morphine alkaloid | 108. | Heroin |
| 75. | Concentrate of poppy straw (M) | 109. | Hydrocodone |
| 76. | Concentrate of poppy straw (M)AMA | 110. | Hydromorphinol |
| 77. | Concentrate of poppy straw (M)-ATA | 111. | Hydromorphone |
| 78. | Desomorphine | 112. | Hydromorphone-3GLUC |
| 79. | Dextromoramide | 113. | Hydromorphone-N-oxide |
| 80. | Dextropropoxyphene | 114. | Hydroxypethidine |
| 81. | Diampromide | 115. | Isomethadone |
| 82. | Diethylthiambutene | 116. | Ketobemidone |
| 83. | Difenoxin | 117. | L-Alphacetylmethadol |
| 84. | Dihydrocodeine | 118. | Levo-A-acetylmethadol |
| 85. | Dihydroetorphine | 119. | Levomethorphan |
| 86. | Dihydromorphone-6GLUC | 120. | Levomoramide |
| 87. | Dihyromorphine | 121. | Levoephacynol |
| 88. | Dihydromorphine-6GLUC | 122. | Levopropoxyphene |
| 89. | Dihydrothebaine | 123. | L-Methadone |
| 90. | Dimenoxadol | 124. | L-Isomethadone |
| 91. | Dimephtanol | 125. | L-Methadone |
| 92. | Dimethylmorphine | 126. | L-methadone |
| 93. | Dimethyldihydrocodine | 127. | Metazocine |
| 94. | Dextropropoxyphene | 128. | Methadone |
| 95. | Diphenoxylate | 129. | Methadone intermediate |
| 96. | Dipipanone | 130. | Methylmorphinone |
| 97. | D-Isomethadone | 131. | Moramidetintermediate |
| 98. | Drotebanol | 132. | Morphenine |
| 99. | Ethylmethylthiambutene | 133. | Morphenine |
| 100. | Ethylmorphine | 134. | Morphenine-3,6GLUC |
| 101. | Etonitazene | 135. | Morphenine-3BD,GLUC |
| 102. | Etorphine | 136. | Morphenine-3BD,GLUC |

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143. Morphine-6-B-D-glucuronide
144. Morphine-6GLUC
145. Morphine-DIMETETH
146. Morphine-METHYBRO
147. Morphine-METHYIOD
148. Morphine-N-oxide
149. MPPP
150. MT-45
151. Myrophine
152. Nicocodine
153. Nicodicodine
154. Nicomorphine
155. Noracymethadol
156. Norcodeine
157. Norlevorphanol
158. Normethadone
159. Normethadone intermediate
160. Normorphine
161. Normorphine-3GLUC
162. Norpipanone
163. Ocfentanyl
164. OLD Morphine-6GLUC
165. Opium
166. Opium - non medical use
167. Opium marc
168. Opium, prepared
169. Oripavine
170. Oxycodeone
171. Oxycodone-N-oxide
172. Oxyomorphone
173. Papaver bracteatum
174. para-Fluorofentanyl
175. PEPAP
176. Pethidine
177. Pethidine intermediate A
178. Pethidine intermediate B
179. Pethidine intermediate C
180. Phenadoxone
181. Phenampromide
182. Phenazocine
183. Phenomorphan
184. Phenoperidine
185. Pholcodine
186. Piminodine
187. Piritramide
188. Poppy straw (C) GW
189. Poppy straw (M)
190. Poppy straw (M) GW
191. Poppy straw (M) GW-ACA
192. Poppy straw (M) GW-AMA
193. Poppy straw (M) GW-AOA
194. Poppy straw (M) GW-ATA
195. Poppy straw (M)-ACA
196. Poppy straw (M)-AMA
197. Poppy straw (M)-AOA
198. Poppy straw (M)-ATA
199. Poppy straw (N) GW
200. Poppy straw (T)
201. Poppy straw (T) GW
202. Poppy straw (T) GW-ACA
203. Poppy straw (T) GW-AMA
204. Poppy straw (T) GW-AOA
205. Poppy straw (T)-ACA
206. Poppy straw (T)-AOA
207. Poppy straw (T)-ATA
208. Poppy straw (total)
209. Poppy straw (total)
anhydrous codeine alkaloid
210. Poppy straw (total)
anhydrous morphine alkaloid
211. Proheptazine
212. Properidine
213. Propiram
214. Racemethorphan
215. Racemoramide
216. Racemorphan
217. Remifentanil
218. Sufentanil
219. Tetrahydrofuranylfentanyl
| 220. | Thebacon       | 223. | Tilidine       |
| 221. | Thebaine      | 224. | Trimeperidine  |
| 222. | Thiofentanyl  | 225. | U-47700        |

Substances **excluded** from our opioid consumption calculation:

1. ???
2. Cannabis
3. Cannabis (non-medical use)
4. Cannabis oil
5. Cannabis resin
6. Cannabis resin-non medical use
7. Coca leaf
8. Coca leaf - non medical use
9. Coca paste
10. Cocaine
11. DUMMY
12. Ecgonine
13. Ecgonine-Benetest
14. Ecgonine-Bezest,4
15. Ecgonine-Bezprest
16. Ecgonine-Cinmeest
17. Ecgonine-Diflbene
18. Ecgonine-Ethylest
19. Ecgonine-Methyest
20. Ecgonine-M-Hydrox
21. Not covered substances
22. Other
23. Schedule III preparations
24. Special C.P.S
25. Unknown (ND019---)
26. Unspecified sources
27. Blank

**Box S2:** Calculations for global, regional and national consumption of opioids

INCB recommends using a three-year mean to display the data, and previous studies have used this to account for annual variation in reporting, providing more stable data (Bosetti et al., 2018). To calculate the annual mean consumption of opioids, we summed data for each year (2015-17) in kgs for each country, divided by three to determine the average, converted to mg and divided by 2016 population data from the WHO Global Health Observatory for each country (WHO, 2019). Here we provide an example using Sweden’s data:

\[
\text{944.88 kg (2015) + 949.176 kg (2016) + 996.128 kg (2017)} = 2890.18 \text{ kg}
\]

\[
\frac{((2890.18/3)*1000000)/9838000 = 97.93 \text{ mg per person in Sweden}}{}
\]
Table S1: Master list of Anatomical Therapeutic Classification (ATC) chemical substance codes for opioids

| Drug name                  | ATC code                                |
|----------------------------|-----------------------------------------|
| Acetyldihydrocodeine       | R05DA12                                 |
| Alfentanil                | N01AH02                                 |
| Anileridine               | N01AH05                                 |
| Bezitramide               | N02AC05                                 |
| Buprenorphine             | N02AE01, N07BC01, N07BC51               |
| Butorphanol               | N02AF01                                 |
| Codeine                   | R05DA04, N02AJ07, N02AJ08, N02AJ09, N02AJ06, N02AA59, N02AA79 |
| Dextromethorphan           | R05DA09                                 |
| Dextromoramide            | N02AC01                                 |
| Dextropropoxyphene         | N02AC04, N02AC54, N02AC74               |
| Dezocine                  | N02AX03                                 |
| Diamorphine               | N07BC06                                 |
| Difenoxin                 | A07DA04                                 |
| Dihydrocodeine            | N02AA08, N02AJ02, N02AJ03, N02AJ01, N02AA58 |
| Dimenhydrinate            | R05DA11                                 |
| Diphenoxylate             | A07DA01                                 |
| Eluxadoline               | A07DA06                                 |
| Ethylmorphine             | R05DA01, S01XA06                        |
| Fentanyl                  | N01AH01, N02AB03, N01AH51, QN02AB03     |
| Hydrocodone               | R05DA03                                 |
| Hydromorphone             | N02AA03, N02AA53, N02AG04               |
| Ketobemidone              | N02AB01, N02AG02                        |
| Levacetylmethadol         | N07BC03                                 |
| Levomethadone             | N07BC05                                 |
| Lofexidine                | N07BC04                                 |
| Opioid/Analgesic | Chemical Code(s) |
|------------------|-----------------|
| Loperamide       | A07DA03, A07DA05, A07DA53 |
| Meptazinol       | N02AX05          |
| Methadone        | N07BC02, N02AC52 |
| Morphine         | N02AA01, N02AG01, A07DA52, N02AA51 |
| Nalbuphine       | N02AF02          |
| Nicomorphine     | N02AA04          |
| Normethadone     | R05DA06          |
| Noscapine        | R05DA07          |
| Opium            | A07DA02, N02AA02, R05DA05, R05DA20, R05FA02, R05FA01 |
| Oxycodone        | N02AA05, N02AA55, N02AA56, N02AJ018, N02AJ019, N02AJ017 |
| Papaveretum      | N02AA10          |
| Pentazocine      | N02AD01          |
| Pethidine        | N02AB02, N02AG03,N02AB52, N02AB72 |
| Phenazocine      | N02AD02          |
| Phenoperidine    | N01AH04          |
| Pholcodine       | R05DA08          |
| Piritramide      | N02AC03          |
| Remifentanil     | N01AH06          |
| Sufentanil       | N01AH03          |
| Tapentadol       | N02AX06          |
| Thebacon         | R05DA10          |
| Tilidine         | N02AX01          |
| Tramadol         | N02AX02, N02AJ013, N02AJ014, N02AJ015 |
Table S2: Sources of data for country characteristics used in the regression model

| Country characteristics                  | Source                                                                 |
|------------------------------------------|------------------------------------------------------------------------|
| Geographical region                      | WHO. (2019). Global Health Observatory data repository. World Health Statistics; World Health Organization. Retrieved May 18, 2019: http://apps.who.int/gho/data/node.main.1?lang=en |
| Population (in 2016)                     | Central Intelligence Agency. (2018). GDP - per capita. The World Factbook. Retrieved May 18, 2019: https://www.cia.gov/library/publications/resources/the-world-factbook/fields/211rank.html |
| Healthcare expenditure per capita (US$, 2015) | United Nations Development Programme. Human Development Data (1990-2017). Human Development Reports. Retrieved May 18, 2019: http://hdr.undp.org/en/data |
| Life expectancy at birth (in years) for all sexes (in 2016) | Transparency International. Corruption Perceptions Index 2016. Transparency International. Retrieved May 18, 2019: https://www.transparency.org/news/feature/corruption_perceptions_index_2016 |
| Gross domestic product (GDP) per capita (July 2017 to June 2018) | Central Intelligence Agency. (2018). GDP - per capita. The World Factbook. Retrieved May 18, 2019: https://www.cia.gov/library/publications/resources/the-world-factbook/fields/211rank.html |
| Human development index (2016) | United Nations Development Programme. Human Development Data (1990-2017). Human Development Reports. Retrieved May 18, 2019: http://hdr.undp.org/en/data |
| Corruption perception score (2016) | Transparency International. Corruption Perceptions Index 2016. Transparency International. Retrieved May 18, 2019: https://www.transparency.org/news/feature/corruption_perceptions_index_2016 |
**Table S3:** Availability of opioid consumption data for countries with national EMLs by type of opioid

| Type of opioid     | No. of countries with consumption data (%) | No. of countries with consumption not equal to 0 kg (%) |
|-------------------|-------------------------------------------|------------------------------------------------------|
| Morphine          | 137 (100)                                 | 111 (81)                                             |
| Fentanyl          | 134 (98)                                  | 107 (78)                                             |
| Codeine           | 129 (94)                                  | 38 (28)                                              |
| Pethidine         | 117 (85)                                  | 91 (66)                                              |
| Methadone         | 83 (61)                                   | 62 (45)                                              |
| Oxycodone         | 73 (53)                                   | 58 (42)                                              |
| Remifentanil      | 62 (45)                                   | 48 (35)                                              |
| Sufentanil        | 55 (40)                                   | 31 (23)                                              |
| Alfentanil        | 47 (34)                                   | 21 (15)                                              |
| Diamorphine       | 47 (34)                                   | 7 (5)                                                |
| Hydromorphone     | 38 (28)                                   | 20 (15)                                              |
| Pholcodine        | 37 (27)                                   | 3 (2)                                                |
| Dihydrocodeine    | 36 (26)                                   | 5 (4)                                                |
| Hydrocodone       | 34 (25)                                   | 6 (4)                                                |
| Dextropropoxyphene| 30 (22)                                   | 2 (1)                                                |
| Diphenoxylate     | 28 (20)                                   | 0 (0)                                                |
| Opium             | 27 (20)                                   | 11 (8)                                               |
| Tilidine          | 20 (15)                                   | 8 (6)                                                |
| Trimeperidine     | 13 (9)                                    | 10 (7)                                               |
| Piritramide       | 6 (4)                                     | 3 (2)                                                |
### Table S4: Opioids listed in the 20th edition of the WHO Model List of Essential Medicines

| Drug                                           | Dose & route of administration                                                                 | Additional notes                                      |
|------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------|
| **Anaesthetics, preoperative medicines & medical gases: Preoperative medication & sedation for short-term procedures** |                                                                                               |                                                       |
| morphine                                       | Injection: 10 mg (sulfate or hydrochloride) in 1 mL ampoule                                    |                                                       |
| **Medicines for pain and palliative care: opioid analgesics**                                           |                                                                                               |                                                       |
| codeine                                        | Tablet: 30 mg (phosphate)                                                                     |                                                       |
| fentanyl                                       | Transdermal patch: 12 µg/hr; 25 µg/hr; 50 µg/hr; 75 µg/hr; 100 µg/hr                           | cancer pain                                           |
| methadone                                      | Tablet: 5 mg; 10 mg (as hydrochloride); Oral liquid: 5mg/5mL; 10mg/5mL (as hydrochloride); Concentrate for oral liquid: 5 mg/mL; 10mg/mL (as hydrochloride) | complementary* list; cancer pain                      |
| morphine                                       | Granules (slow-release; to mix with water): 20 mg to 200 mg (morphine sulfate); Injection: 10 mg (morphine hydrochloride or morphine sulfate) in 1 mL ampoule; Oral liquid: 10 mg (morphine hydrochloride or morphine sulfate)/5 mL; Tablet (slow release): 10 mg to 200 mg (morphine hydrochloride or morphine sulfate); Tablet (immediate release): 10 mg (morphine sulfate). | Alternatives limited to hydromorphone and oxycodone  |
| **Medicines for pain and palliative care: medicines for other common symptoms in palliative care**                                           |                                                                                               |                                                       |
| loperamide                                      | Solid oral dosage form: 2 mg                                                                  |                                                       |
| **Medicines for mental and behavioural disorders: medicines for disorders due to psychoactive substances**                                           |                                                                                               |                                                       |
| methadone                                      | Concentrate for oral liquid: 5 mg/mL; 10 mg/mL (hydrochloride). Oral liquid: 5 mg/5 mL; 10 mg/5 mL (hydrochloride). | complementary* list; buprenorphine is an alternative; should only be used alongside an established support programme |
*complementary list: presents essential medicines for priority diseases, for which specialized diagnostic or monitoring facilities, and/or specialist medical care, and/or specialist training are needed. In case of doubt, medicines may also be listed as complementary on the basis of consistent higher costs or less attractive cost-effectiveness in a variety of settings.
Table S5: Summary of opioid consumption and national essential medicines lists (EMLs) data by country (n=137) in alphabetical order.

| Country         | Mean opioid consumption (mg/person) | Year of list | Number of opioids in EMLs (% of all drugs) | Type of opioids in EMLs                                           | Similarity with WHO list, no. (%) | Differences from WHO list, no. (%) |
|-----------------|------------------------------------|--------------|-------------------------------------------|-------------------------------------------------------------------|-----------------------------------|----------------------------------|
| Afghanistan     | 0.555                              | 2014         | 6 (2.31)                                  | methadone, morphine, buprenorphine, opium, pethidine & tramadol   | 2 (40)                            | 4 (67)                           |
| Albania         | 5.057                              | 2011         | 3 (1.40)                                  | codeine, morphine & pethidine                                     | 2 (40)                            | 1 (33)                           |
| Algeria         | 0.164                              | 2016         | 7 (1.56)                                  | codeine, loperamide, buprenorphine, dextromethorphan, dextropropoxyphene, pholcodine & tramadol | 2 (40)                            | 5 (71)                           |
| Angola          | 0.002                              | 2008         | 1 (1.56)                                  | fentanyl                                                          | 1 (20)                            | 0 (0)                            |
| Antigua & Barbuda | 0                                 | 2007         | 6 (2.04)                                  | codeine, fentanyl, methadone, morphine, pethidine & tramadol      | 4 (80)                            | 2 (33)                           |
| Argentina       | 14.329                             | 2011         | 8 (1.69)                                  | codeine, fentanyl, loperamide, morphine, dextromethorphan, dextropropoxyphene, remifentanil & tramadol | 4 (80)                            | 4 (50)                           |
| Armenia         | 3.636                              | 2010         | 4 (1.48)                                  | fentanyl, loperamide, morphine & trimeperidine                    | 3 (60)                            | 1 (25)                           |
| Bahrain         | 12.055                             | 2015         | 6 (1.09)                                  | fentanyl, loperamide, methadone, morphine, pethidine & remifentanil | 4 (80)                            | 2 (33)                           |
| Bangladesh      | 0.826                              | 2008         | 2 (1.07)                                  | morphine & pethidine                                             | 1 (20)                            | 1 (50)                           |
| Barbados        | 31.185                             | 2011         | 12 (1.89)                                 | codeine, fentanyl, loperamide, morphine, dextromethorphan, dextropropoxyphene, dihydrocodeine, diphenoxylate, papaveretum, pentazocine, pethidine & tramadol | 4 (80)                            | 8 (67)                           |
| Belarus         | 4.852                              | 2012         | 9 (2.42)                                  | fentanyl, loperamide, morphine, buprenorphine, butorphanol        | 3 (60)                            | 6 (67)                           |
| Country                      | Number of Opioids | Year | Consumption | Opioids Contained                                                                 |
|------------------------------|-------------------|------|-------------|----------------------------------------------------------------------------------|
| Belize                       | 4.331             | 2008 | 9 (2.40)    | codeine, fentanyl, loperamide, methadone, morphine, buprenorphine, hydromorphone, oxycodone & pethidine |
| Bhutan                       | 0.247             | 2016 | 5 (1.70)    | codeine, fentanyl, morphine, pethidine & tramadol                                  |
| Bolivarian Rep. of Venezuela | 0.129             | 2011 | 7 (2.26)    | codeine, fentanyl, morphine, dextromethorphan, oxycodone, pethidine & tramadol    |
| Bolivia                      | 0.303             | 2011 | 8 (2.25)    | codeine, fentanyl, loperamide, methadone, morphine, dextromethorphan, pethidine & remifentanil |
| Bosnia & Herzegovina         | 3.921             | 2009 | 6 (3.30)    | codeine, loperamide, methadone, buprenorphine, pholcodine & tramadol              |
| Botswana                     | 3.165             | 2012 | 7 (2.06)    | codeine, fentanyl, loperamide, morphine, dihydrocodeine, pethidine & tramadol    |
| Brazil                       | 5.663             | 2014 | 3 (0.74)    | codeine, methadone & morphine                                                    |
| Bulgaria                     | 25.534            | 2011 | 1 (0.28)    | fentanyl                                                                         |
| Burkina Faso                 | 0.054             | 2014 | 9 (3.28)    | codeine, fentanyl, loperamide, methadone, morphine, buprenorphine, nallbuphine, remifentanil & sufentanil |
| Burundi                      | 0.049             | 2012 | 4 (1.36)    | codeine, fentanyl, morphine & tramadol                                            |
| Cabo Verde                   | 0.6               | 2009 | 8 (1.41)    | codeine, fentanyl, loperamide, methadone, morphine, alfentanil, pethidine & tramadol |
| Cambodia                     |                   | 2003 | 0 (0)       | 0                                                                                 |
| Cameroon                     | 0                 | 2010 | 10 (2.83)   | codeine, fentanyl, loperamide, morphine, buprenorphine, dextromethorphan, pethidine & sufentanil |
| Central African Republic     | 0                 | 2009 | 7 (2.37)    | codeine, loperamide, morphine, noscapine, opium, pentazocine & pethidine         |
| Country                          | Codeine, Fentanyl & Morphine | Codeine, Fentanyl, Loperamide, Methadone, Morphine, Pargiverine, Pethidine & Tramadol | Codeine, Fentanyl, Morphine, Diphenoxylate & Pethidine | Codeine, Fentanyl, Morphine, Dihydrocodeine, Hydromorphone, Oxycodone & Pethidine | Codeine, Fentanyl, Methadone, Methadon & Pethidine | Codeine, Fentanyl, Methadone, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, Methadon, 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| Country          | Registration | Year | Quantity | Drugs                                                                                       | Quantity | Percentage |
|------------------|--------------|------|----------|--------------------------------------------------------------------------------------------|----------|------------|
| Djibouti         | 0            | 2007 | 4 (1.99) | fentanyl, loperamide, morphine & pethidine                                                 | 3 (60)   |            |
| Dominica         | 6.788        | 2007 | 5 (1.75) | fentanyl, methadone, morphine, pethidine & tramadol                                         | 3 (60)   | 2 (40)     |
| Dominican Republic | 1.022     | 2015 | 6 (1.68) | codeine, fentanyl, loperamide, morphine, nalbuphine & tramadol                             | 4 (80)   | 2 (33)     |
| Ecuador          | 0.859        | 2013 | 10 (2.71)| codeine, fentanyl, loperamide, methadone, morphine, buprenorphine, hydromorphone, oxycodone, remifentanil & tramadol | 5 (100)  | 5 (50)     |
| Egypt            | 0.377        | 2012 | 6 (1.85) | fentanyl, methadone, morphine, dextromethorphan, pethidine & tramadol                      | 3 (60)   | 3 (50)     |
| El Salvador      | 4.481        | 2009 | 6 (1.66) | fentanyl, loperamide, morphine, nalbuphine, pethidine & tramadol                           | 3 (60)   | 3 (50)     |
| Eritrea          | 0            | 2010 | 6 (1.78) | codeine, loperamide, morphine, dextromethorphan, pethidine & tramadol                      | 3 (60)   | 3 (50)     |
| Estonia          | 26.066       | 2012 | 8 (1.98) | codeine, fentanyl, loperamide, methadone, morphine, diphenoxylate, oxycodone & tramadol   | 5 (100)  | 3 (38)     |
| Ethiopia         | 0.539        | 2014 | 11 (1.55)| codeine, fentanyl, loperamide, methadone, morphine, dextromethorphan, diphenoxylate, pentazocine, pethidine, pholcodine & tramadol | 5 (100)  | 6 (55)     |
| Fiji             | 3.277        | 2015 | 6 (2.02) | codeine, fentanyl, methadone, morphine, diphenoxylate & pethidine                         | 4 (80)   | 2 (33)     |
| Gambia           | 0            | 2001 | 5 (3.03) | codeine, loperamide, morphine, dihydrocodeine & pethidine                                | 3 (60)   | 2 (40)     |
| Georgia          | 14.79        | 2007 | 4 (1.61) | fentanyl, loperamide, morphine & dextromethorphan                                          | 3 (60)   | 1 (25)     |
| Ghana            | 2.672        | 2010 | 5 (1.65) | codeine, fentanyl, morphine, pethidine & tramadol                                          | 3 (60)   | 2 (40)     |
| Grenada          | 0            | 2007 | 5 (1.76) | fentanyl, methadone, morphine, pethidine & tramadol                                       | 3 (60)   | 2 (40)     |
| Guinea           | 0            | 2012 | 5 (2.09) | codeine, loperamide, morphine, pentazocine & pethidine                                   | 3 (60)   | 2 (40)     |
| Country                      | 2014 Codeine | 2015 Codeine | 2016 Codeine | 2017 Codeine | 2018 Codeine | 2019 Codeine | 2020 Codeine |
|------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Guyana                       | 10.216       | 2010         | 6 (2.14)     | codeine, fentanyl, loperamide, methadone, morphine & pethidine | 5 (100)      | 1 (17)       |              |
| Haiti                        | 0.028        | 2012         | 2 (1.02)     | fentanyl & morphine | 2 (40)       | 0 (0)        |              |
| Honduras                     | 0.734        | 2009         | 8 (2.17)     | codeine, fentanyl, loperamide, morphine, dextromethorphan, oxycodone, pethidine & tramadol | 4 (80)       | 4 (50)       |              |
| India                        | 0.527        | 2015         | 4 (1.09)     | fentanyl, morphine, pentazocine & tramadol | 2 (40)       | 2 (50)       |              |
| Indonesia                    | 0.708        | 2011         | 7 (2.51)     | codeine, fentanyl, methadone, morphine, dextromethorphan, pethidine & sufentanil | 4 (80)       | 3 (43)       |              |
| Iraq                         | 0            | 2010         | 12 (2.08)    | codeine, fentanyl, loperamide, morphine, dextromethorphan, dextropropoxyphene, dihydrocodeine, diphenoxylate, oxycodone, pentazocine, pethidine & tramadol | 4 (80)       | 8 (67)       |              |
| Islamic Republic of Iran     | 3.325        | 2014         | 16 (1.79)    | codeine, fentanyl, loperamide, methadone, morphine, alfentanil, buprenorphine, dextromethorphan, diphenoxylate, hydromorphone, oxycodone, pentazocine, pethidine, remifentanil, sufentanil & tramadol | 5 (100)      | 11 (69)      |              |
| Jamaica                      | 7.241        | 2012         | 12 (2.61)    | codeine, fentanyl, loperamide, methadone, morphine, dextromethorphan, diphenoxylate, oxycodone, pethidine, pholcodine, remifentanil & tramadol | 5 (100)      | 7 (58)       |              |
| Jordan                       | 3.98         | 2011         | 10 (1.69)    | codeine, fentanyl, loperamide, methadone, morphine, alfentanil, dihydrocodeine, pethidine, remifentanil & tramadol | 5 (100)      | 5 (50)       |              |
| Kenya                        | 1.927        | 2016         | 6 (1.44)     | codeine, fentanyl, loperamide, methadone, morphine & buprenorphine | 5 (100)      | 1 (17)       |              |
| Kiribati                     | 0.288        | 2009         | 5 (2.29)     | codeine, fentanyl, loperamide, morphine & pethidine | 4 (80)       | 1 (20)       |              |
| Kyrgyzstan                   | 5.936        | 2009         | 5 (1.58)     | fentanyl, methadone, morphine, buprenorphine & trimeperidine | 3 (60)       | 2 (40)       |              |
| Latvia                       | 11.521       | 2012         | 6 (1.95)     | fentanyl, morphine, dihydrocodeine, tilidine, tramadol & trimeperidine | 2 (40)       | 4 (67)       |              |
| Country     | Population | Year | Opioids Used                                               | Deaths | Fatalities |
|------------|------------|------|-----------------------------------------------------------|--------|------------|
| Lebanon    | 4.123      | 2014 | fentanyl, loperamide, morphine, dextromethorphan, pethidine & tramadol | 3 (60) | 3 (50)     |
| Lesotho    | 0          | 2005 | morphine, pethidine & diamorphine                          | 1 (20) | 2 (67)     |
| Liberia    | 0          | 2011 | loperamide, morphine, buprenorphine & pethidine            | 2 (40) | 2 (50)     |
| Lithuania  | 10.013     | 2012 | fentanyl, morphine & tramadol                              | 2 (40) | 1 (33)     |
| Madagascar | 0.037      | 2008 | fentanyl, loperamide, morphine, dextromethorphan, dextropropoxyphene, noscapine & pethidine | 3 (60) | 4 (57)     |
| Malawi     | 1.485      | 2015 | codeine, fentanyl, loperamide, morphine, dihydrocodeine, pethidine & tramadol | 4 (80) | 3 (43)     |
| Malaysia   | 16.407     | 2014 | loperamide, methadone, morphine, dihydrocodeine, diphenoxylate | 3 (60) | 3 (50)     |
| Maldives   | 0.763      | 2011 | codeine, fentanyl, loperamide, morphine, dextromethorphan, pentazocine, pethidine, pholcodine & tramadol | 4 (80) | 5 (56)     |
| Mali       | 0          | 2012 | codeine, fentanyl, loperamide, morphine & tramadol         | 4 (80) | 2 (33)     |
| Malta      | 42.147     | 2008 | codeine, fentanyl, loperamide, methadone, morphine, buprenorphine, dextromethorphan, dextropropoxyphene, dihydrocodeine, pethidine, pholcodine, remifentanil & tramadol | 5 (100) | 8 (62)     |
| Marshall Islands | 0   | 2007 | codeine, fentanyl, loperamide, morphine, nalbuphine, pethidine & tramadol | 4 (80) | 3 (43)     |
| Mauritania | 0          | 2008 | loperamide, morphine & buprenorphine                       | 2 (40) | 1 (33)     |
| Mexico     | 0.709      | 2011 | codeine, fentanyl, loperamide, morphine, buprenorphine, dextromethorphan, dextropropoxyphene, hydromorphone, nalbuphine, oxycodone, remifentanil & tramadol | 4 (80) | 8 (67)     |
| Mongolia   | 3.134      | 2009 | codeine, fentanyl, morphine & tramadol                     | 3 (60) | 1 (25)     |
| Country               | Population | Year | Opioids | Pethidine |
|----------------------|------------|------|---------|-----------|
| Montenegro           | 5.659      | 2011 | 8 (1.77)| 4 (80)    |
| Morocco              | 1.289      | 2012 | 10 (2.91)| 5 (100)  |
| Mozambique           | 0.223      | 2016 | 5 (1.93)| 4 (80)    |
| Namibia              | 3.66       | 2016 | 9 (2.34)| 5 (100)  |
| Nauru                | 0          | 2010 | 7 (3.03)| 4 (80)    |
| Nepal                | 0.521      | 2011 | 4 (1.33)| 2 (40)    |
| Nicaragua            | 0.677      | 2011 | 2 (0.73)| 2 (40)    |
| Nigeria              | 0.012      | 2010 | 10 (3.27)| 5 (100)  |
| Niue                 | 6.001      | 2006 | 4 (1.26)| 3 (60)    |
| Oman                 | 19.292     | 2009 | 10 (1.73)| 5 (100)  |
| Pakistan             | 0.033      | 2016 | 3 (0.80)| 3 (60)    |
| Palau                | 15.53      | 2006 | 7 (2.59)| 4 (80)    |
| Papua New Guinea     | 1.782      | 2012 | 4 (1.48)| 3 (60)    |
| Country               | Code | Year | Entry | Drugs                                                                 | Depressed | Taken |
|----------------------|------|------|-------|----------------------------------------------------------------------|-----------|-------|
| Paraguay             | 0    | 2009 | 6 (1.95) | codeine, fentanyl, morphine, alfentanil, dextromethorphan & pethidine | 3 (60)    | 3 (50) |
| Peru                 | 2.271| 2012 | 7 (1.64) | codeine, fentanyl, morphine, dextromethorphan, oxycodone, pethidine & tramadol | 3 (60)    | 4 (57) |
| Philippines          | 0.36 | 2008 | 10 (1.93) | codeine, fentanyl, loperamide, morphine, butorphanol, dextromethorphan, nalbuphine, oxycodone, pethidine & tramadol | 4 (80)    | 6 (60) |
| Poland               | 17.594| 2017 | 9 (2.03) | fentanyl, loperamide, methadone, morphine, buprenorphine, dihydrocodeine, oxycodone, tapentadol & tramadol | 4 (80)    | 5 (56) |
| Portugal             | 17.931| 2011 | 11 (1.21) | codeine, fentanyl, loperamide, methadone, morphine, buprenorphine, dextromethorphan, dextropropoxyphene, hydromorphone, pargeverine & tramadol | 5 (100)   | 6 (55) |
| Romania              | 10.459| 2012 | 11 (1.73) | codeine, fentanyl, methadone, morphine, buprenorphine, dextromethorphan, dihydrocodeine, oxycodone, pentazocine, pethidine & tramadol | 4 (80)    | 7 (64) |
| Russian Federation   | 1.812 | 2014 | 5 (0.96) | fentanyl, loperamide, morphine, tramadol & trimiperidine | 3 (60)    | 2 (40) |
| Rwanda               | 0.597 | 2010 | 6 (2.08) | codeine, fentanyl, morphine, pentazocine, pethidine & tramadol | 3 (60)    | 3 (50) |
| Saint Kitts & Nevis  | 0    | 2007 | 5 (1.72) | fentanyl, methadone, morphine, pethidine & tramadol | 3 (60)    | 2 (40) |
| Saint Lucia          | 0    | 2007 | 5 (1.72) | fentanyl, methadone, morphine, pethidine & tramadol | 3 (60)    | 2 (40) |
| Saint Vincent & the Grenadines | 5.834 | 2010 | 5 (1.87) | codeine, fentanyl, methadone, morphine & pethidine | 4 (80)    | 1 (20) |
| Senegal              | 1.241 | 2013 | 9 (2.65) | codeine, fentanyl, methadone, morphine, alfentanil, buprenorphine, nalbuphine, sufentanil & tramadol | 4 (80)    | 5 (56) |
| Country                  | 2021 GDP per Capita (2010$) | Year | Opioids Listed |
|-------------------------|-----------------------------|------|----------------|
| Serbia                  | 9.93                        | 2010 | fentanyl, loperamide, methadone, morphine, alfentanil, hydromorphone, pethidine, remifentanil, sufentanil & tramadol |
| Seychelles              | 20.909                      | 2010 | codeine, fentanyl, morphine, pethidine & tramadol |
| Slovakia                | 14.229                      | 2012 | codeine, fentanyl, loperamide, morphine, buprenorphine, dextromethorphan, difenoxin, dihydrocodeine, diphenoxylate, eluxadoline, hydromorphone, opium, oxycodone, pentazocine, pethidine, sufentanil, tapentadol, tramadol & tramperidine |
| Slovenia                | 64.451                      | 2017 | codeine, fentanyl, loperamide, methadone, morphine, alfentanil, buprenorphine, hydromorphone, oxycodone, pethidine, pholcodine, piritramide, remifentanil, tapentadol, tramadol & tramperidine |
| Solomon Islands         | 0.91                        | 2017 | codeine, fentanyl, morphine, oxycodone & pethidine |
| Somalia                 | 0                           | 2006 | pethidine |
| South Africa            | 16.377                      | 2014 | loperamide, morphine, pethidine & tramadol |
| Sri Lanka               | 6.003                       | 2013 | fentanyl, loperamide, methadone & tramadol |
| Sudan                   | 0.242                       | 2014 | loperamide, morphine, dextromethorphan, diphenoxylate & pethidine |
| Suriname                | 0.293                       | 2014 | codeine, fentanyl, loperamide, morphine & sufentanil |
| Sweden                  | 97.926                      | 2016 | codeine, fentanyl, loperamide, morphine, buprenorphine, hydromorphone & oxycodone |
| Syrian Arab Republic    | 1.642                       | 2008 | codeine, fentanyl, morphine, buprenorphine, dextromethorphan, dextropropoxyphene, diphenoxylate, hydrocodone, noscapine, oxycodone, |
| Country                  | Codeine, Fentanyl, Methadone, Morphine, Alfentanil, Pentazocine, Remifentanil, Sufentanil & Tramadol | Codeine, Fentanyl, Methadone, Morphine, Buprenorphine, Dextromethorphan, Nalbuphine, Opium, Pethidine & Tramadol | 2008 | 2009 |
|-------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------|------|
| Tajikistan              | Codeine, Fentanyl, Loperamide, Morphine, Tramadol & Trimeperidine                               | Codeine, Fentanyl, Loperamide, Morphine, Tramadol & Trimeperidine                                        | 3.221| 2013 |
| Thailand                | Codeine, Fentanyl, Loperamide, Methadone, Morphine, Buprenorphine, Dextromethorphan, Nalbuphine, Opium, Pethidine & Tramadol | Codeine, Fentanyl, Loperamide, Methadone, Morphine, Buprenorphine, Dextromethorphan, Tramadol & Trimeperidine | 26.076| 2015 |
| The Congo               | Codeine, Fentanyl, Loperamide, Morphine, Buprenorphine, Dextromethorphan, Remifentanil, Sufentanil & Tramadol | Codeine, Fentanyl, Loperamide, Morphine, Buprenorphine, Dextromethorphan, Tramadol & Trimeperidine | 2.739| 2012 |
| The Republic of Moldova | Codeine, Fentanyl, Methadone, Morphine, Alfentanil, Pentazocine, Remifentanil, Sufentanil & Tramadol | Codeine, Fentanyl, Methadone, Morphine, Alfentanil, Pentazocine, Remifentanil, Sufentanil & Tramadol | 0.111| 2012 |
| The Republic of North Macedonia | Codeine, Fentanyl, Methadone, Morphine, Alfentanil, Pentazocine, Remifentanil, Sufentanil & Tramadol | Codeine, Fentanyl, Methadone, Morphine, Alfentanil, Pentazocine, Remifentanil, Sufentanil & Tramadol | 4.003| 2010 |
| Timor-Leste             | Codeine, Fentanyl, Morphine & Tramadol                                                          | Codeine, Fentanyl, Morphine & Tramadol                                                                    | 0.113| 2009 |
| Togo                    | Codeine, Fentanyl, Loperamide, Morphine, Alfentanil, Buprenorphine, Dihydrocodeine, Sufentanil & Tramadol | Codeine, Fentanyl, Loperamide, Morphine, Alfentanil, Buprenorphine, Dihydrocodeine, Sufentanil & Tramadol | 11.087| 2010 |
| Tonga                   | Codeine, Fentanyl, Loperamide, Morphine, Alfentanil, Pethidine & Pholcodine                     | Codeine, Fentanyl, Loperamide, Morphine, Alfentanil, Pethidine & Pholcodine                               | 2.034| 2012 |
| Trinidad & Tobago       | Codeine, Fentanyl, Methadone, Morphine, Dextromethorphan, Pethidine, Pholcodine & Tramadol      | Codeine, Fentanyl, Methadone, Morphine, Dextromethorphan, Pethidine, Pholcodine & Tramadol              | 2.03 | 2010 |
| Tunisia                 | Codeine, Fentanyl, Loperamide, Morphine, Alfentanil, Buprenorphine, Dextromethorphan, Dextropropoxyphene, Opium, Pethidine & Pholcodine | Codeine, Fentanyl, Loperamide, Morphine, Alfentanil, Buprenorphine, Dextromethorphan, Dextropropoxyphene, Opium, Pethidine & Pholcodine | 2.739| 2012 |
| Tuvalu                  | Codeine, Fentanyl, Morphine & Pethidine                                                        | Codeine, Fentanyl, Morphine & Pethidine                                                                   | 2.03 | 2010 |
| Uganda                  | Codeine, Fentanyl, Loperamide, Morphine, Papaveretum, Pethidine & Remifentanil                  | Codeine, Fentanyl, Loperamide, Morphine, Papaveretum, Pethidine & Remifentanil                            | 4.746| 2015 |

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| Country                  | Population | Year | Consumption | Opioids | Number | Opioids in Bold |
|-------------------------|------------|------|-------------|---------|--------|----------------|
| Ukraine                 | 10.253     | 2009 | 3 (1.07)    | methadone, morphine & buprenorphine | 2 (40) | 1 (33) |
| United Republic of Tanzania | 1.159     | 2013 | 6 (1.66)    | codeine, loperamide, methadone, morphine, pethidine & tramadol | 4 (80) | 2 (33) |
| Uruguay                 | 7.419      | 2011 | 8 (1.52)    | codeine, fentanyl, loperamide, methadone, morphine, dextromethorphan, pethidine & tramadol | 5 (100) | 3 (38) |
| Vanuatu                 | 0          | 2006 | 3 (1.69)    | codeine, fentanyl & morphine | 3 (60) | 0 (0) |
| Viet Nam                | 17.481     | 2008 | 9 (1.14)    | codeine, fentanyl, loperamide, morphine, dextromethorphan, dextropropoxyphene, pethidine, sufentanil & tramadol | 4 (80) | 5 (56) |
| Yemen                   | 0          | 2009 | 3 (1.20)    | fentanyl, morphine & pethidine | 2 (40) | 1 (33) |
| Zambia                  | 1.55       | 2013 | 5 (1.74)    | codeine, loperamide, morphine, dihydrocodeine & pethidine | 3 (60) | 2 (40) |
| Zimbabwe                | 2.407      | 2011 | 7 (2.02)    | codeine, fentanyl, loperamide, morphine, alfentanil, pethidine & tramadol | 4 (80) | 3 (43) |

- no consumption reported to the International Narcotics Control Board (INCB);

Opioids in bold are listed in the 20th edition of the WHO Model List of Essential Medicines.
Table S6: Opioids included in national essential medicines lists in descending order for each Anatomical Therapeutic Classification (ATC) subgroup

| Medicine (alternative name) | No. of countries list, n=137 (%) |
|-----------------------------|----------------------------------|
| **Analgesics**              |                                  |
| Morphine                    | 130 (94.9)                       |
| Fentanyl                    | 113 (82.5)                       |
| Codeine                     | 94 (68.6)                        |
| Pethidine (Meperidine)      | 89 (65.0)                        |
| Tramadol                    | 85 (62.0)                        |
| Oxycodone                   | 22 (16.1)                        |
| Dihydrocodeine              | 18 (13.1)                        |
| Pentazocine                 | 16 (11.7)                        |
| Dextropropoxyphene          | 11 (8.0)                         |
| Nalbuphine                  | 11 (8.0)                         |
| Trimeperidine               | 8 (5.8)                          |
| Opium                       | 7 (5.1)                          |
| Papaveretum                 | 3 (2.2)                          |
| Tapentadol                  | 3 (2.2)                          |
| Piritramide                 | 2 (1.5)                          |
| Butorphanol                 | 2 (1.5)                          |
| Pargeverine                 | 2 (1.5)                          |
| Tilidine                    | 2 (1.5)                          |
| Hydrocodone                 | 2 (1.5)                          |
| **Antidiarrheals**          | **87 (64%)**                     |
| Loperamide                  | 83 (60.6)                        |
| Diphenoxylate               | 15 (11.0)                        |
| Eluxadoline                 | 1 (0.7)                          |
| Difenoxin                   | 1 (0.7)                          |
| **Opioid substitution therapies** | **71 (52%)**                     |
| Methadone                   | 56 (40.9)                        |
| Buprenorphine               | 34 (24.8)                        |
| Diamorphine                 | 1 (0.7)                          |
| Cough suppressants       | 34 (25%) |
|--------------------------|----------|
| Dextromethorphan         | 40 (29.2)|
| Hydromorphone            | 14 (10.2)|
| Pholcodine               | 12 (8.8) |
| Noscapine                | 5 (3.7)  |

| Anesthetics              | 36 (26%) |
|--------------------------|----------|
| Remifentanil (Remifentanyl) | 22 (16.1)|
| Sufentanil (Sufentanyl)   | 19 (13.9)|
| Alfentanil               | 16 (11.7)|
Figure S1: Similarities with the WHO’s Model List of Essential Medicines for opioids.
Figure S2: Differences from the WHO’s Model List of Essential Medicines for opioids.
**Table S7:** Descriptive statistics of included variables for countries (n=137) with essential medicines lists

| Variable                                                                 | Median | IQR    |
|-------------------------------------------------------------------------|--------|--------|
| Annual mean consumption of opioids (mg per person) (n=137)               | 2.03   | 0.13 - 6.79 |
| Number of opioids on EMLs (n=137)                                       | 6      | 5 - 9  |
| Population, 2016 (n=137)                                                | 9456000| 2078000 - 2880000 |
| Gross domestic product divided by 100 (GDP, $, USD) per capita, 2017-18 (n=135) | 92     | 36 - 170 |
| Health expenditure ($, USD) per capita, 2015 (n=134)                     | 239.4  | 71.7 - 530.1 |
| Human development index, 2016 (n=130)                                   | 0.706  | 0.553 - 0.776 |
| Life expectancy (years), 2016 (n=129)                                   | 71.9   | 65.1 - 75.7 |
| Corruption perception score, 2016 (n=122)                               | 35     | 28 - 45 |

| Region (n=137)               | Count | %    |
|-----------------------------|-------|------|
| Africa                      | 42    | 30.7 |
| Americas                    | 30    | 21.9 |
| Asia                        | 31    | 22.6 |
| Europe                      | 22    | 16.1 |
| Oceania                     | 12    | 8.8  |
Figure S3: Scatter plot of the relation between the square rooted annual mean opioid consumption (mg/person) for 2015-2017 and the number of opioids included in national essential medicines lists (EMLs) for 137 countries. Each country is represented by a symbol for its geographical region.
References for Supplement

Bosetti, C., Santucci, C., Radrezza, S., Erthal, J., Berterame, S., & Corli, O. (2018). Trends in the consumption of opioids for the treatment of severe pain in Europe, 1990-2016. European Journal of Pain. https://onlinelibrary.wiley.com/doi/abs/10.1002/ejp.1337

United Nations. (2019). World Population Prospects 2019. Department of Economic and Social Affairs, Population Division. https://population.un.org/wpp/Download/Standard/Population/

WHO. (2019). Population Data by country. Global Health Observatory Data Repository; World Health Organization. http://apps.who.int/gho/data/node.main.SDGPOP?lang=en