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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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ABSTRACT

Background: While the Gulf Cooperation Council (GCC) countries have demonstrated a strong commitment to strengthening primary healthcare (PHC), the costs of delivering these services in this region remain relatively unexplored. Understanding the costs of PHC delivery is essential for effective resource allocation and health system efficiency.

Methods: We used an ingredient-based method to estimate the cost of delivering a selection of services at PHC facilities in the six GCC countries in 2019. Services were categorized into eight programmes: immunisation; non-communicable diseases (NCDs); oral and dental care; child health; nutrition; mental health; reproductive, maternal, neonatal, and child health; and general practice. The cost estimation focused on two key ingredients: the costs of drugs and supplies, and the healthcare workforce cost. The coverage rates of specific types of health services, including screening and mental health services, were also estimated. Data for the analysis was obtained from ministries of health, health statistics reports, online databases, national surveys, and scientific literature.

Results: The estimated costs of delivering the selected services for the eight programmes at public PHC facilities in the six GCC countries amounted to US$5.7 billion in 2019. The two programmes that accounted for the highest costs were general practice and NCDs, constituting 76% of the total costs modelled, while the programme with the lowest costs was mental health. Over 8 million individuals did not receive NCD screening services, and over 30 million did not receive needed mental health services in public PHC facilities across the region.

Conclusion: To our knowledge, this is the first study to estimate the costs of services delivered at PHC facilities in the GCC countries. Identifying the main cost drivers and the services which individuals did not receive can be used to help strengthen PHC to improve efficiency and scale up needed services for better health outcomes.

Keywords: health economics, health services research, health systems

SUMMARY BOX

What is already known on this topic	1. Primary care's focus on preventive measures and early interventions leads to reduced disease burden, enhancing overall population health, productivity and lowering healthcare costs. 2. The epidemiological shift towards NCDs is driving the transformation of PHC delivery. 3. GCC countries display a strong commitment to PHC development, but economic evidence remains relatively limited.
What this study adds	1. Delivering a selection of essential services at public PHC facilities cost US$5.7 billion in 2019 to the six GCC countries in 2019. 2. General practice and NCDs stood out as the primary cost driver, constituting 76% of the total costs estimated. 3. The utilization of mental health and NCD screening services in PHC in the region is limited.
How this study might affect research, practice or policy	1. These results support the effective allocation of resources for PHC in GCC based on population health needs. 2. The GCC countries have an opportunity to increase NCD screening services and mental health services in PHC to lead to better health outcomes.

INTRODUCTION

Primary healthcare (PHC) refers to the first point of contact for individuals seeking medical care, but it also encompasses health education, prevention, and promotion[1]. From an economic perspective, investing in primary care is cost-effective, as its focus on preventive measures and early interventions results in reduced disease burden, which translates into overall population health, increased productivity and lower healthcare costs[1-3]. For instance, early detection and management of chronic conditions, such as non-communicable diseases (NCDs), can prevent costly hospitalisations or visits to emergency departments[1]. Additionally, primary care providers can often provide care for a broader range of conditions than specialists, reducing the need for referrals and associated costs.

In 2018, 40 years after the Alma-Ata Declaration, the Astana Declaration renewed the global commitment to PHC and reaffirmed its importance as the foundation of healthcare systems[4]. The Astana Declaration called for increased investment in PHC to strengthen health systems, achieve health-related Sustainable Development Goals, and attain universal health coverage.

Global demographics are changing, with ageing populations, population growth, as well as increasing health literacy, greater access to technology, and public expectations of health services leading to increased demand for healthcare, both globally and in the Eastern Mediterranean Region[5]. These changes, along with an epidemiological shift from communicable towards non-communicable diseases[6-11], are influencing the transformation of PHC delivery. It is estimated that 90% of all health needs can be met at the PHC level, offering countries a clear path forward in improving health outcomes and health system efficiency[12].

The WHO Eastern Mediterranean Region has a long history of strengthening PHC, demonstrated by all countries in the region endorsing the Qatar Declaration on Primary Healthcare in 2008[12]. This commitment to strengthening primary level-based health systems is growing, with a particular focus on family practice as one of the means of achieving universal health coverage (UHC). More recently, WHO EMRO has supported its Member States in the development of PHC-oriented models of care.

Understanding the cost of PHC components can help countries identify practical financing and allocation solutions to direct investment towards areas that reduce costs, such as medical supplies and health personnel training, ultimately enhancing the continuity, efficiency, and quality of health services to meet increasing demand in the Gulf region.

This study had two aims. First, to estimate and compare the costs of delivering a selection of PHC services in the six countries of the Gulf Cooperation Council (GCC): Bahrain, Kuwait, Oman, Qatar, Saudi Arabia

(KSA) and the United Arab Emirates (UAE). Second, to estimate the coverage rates of specific types of health services, including screening and mental health services.

METHODS

Scope of the study

This study estimates the cost of delivering a selection of services at PHC facilities in the public sector arranged under eight different programmes: (1) immunisation; (2) NCDs; (3) oral and dental care; (4) child health; (5) nutrition; (6) mental health; (7) reproductive, maternal, neonatal and child health; and (8) general practice. In this study, general practice included services delivered by physicians qualified to deliver primary care to individuals, their families and their communities through general practice medical training. A comprehensive list of services was extracted from the OneHealth Tool Costing Module[13]. The list was then reviewed, adjusted, and validated with focal persons from the respective health ministry to ensure it accurately reflected the public PHC system. As a result, the services included in this analysis slightly varies from country to country. The services included for each country can be found in the supplemental materials (Supplemented Material 1).

Data sources

Demographic data were obtained from official population censuses or estimates[14-18]. Disease prevalence and incidence were obtained from annual health statistics reports[19-22], national surveys, international or national databases, and local and regional literature. The number of services delivered was obtained from the focal persons from the health ministry or annual health statistics reports. When unavailable, we used proxy indicators or made assumptions based on regional and international literature. The costs of drugs and supplies and staff time requirements were extracted from the OneHealth Tool Costing Module[13], except for Qatar where standard drugs and supplies costs were completed by actual costs provided by the Primary Health Care Corporation (PHCC). However, the costs estimated in this study for Qatar remain lower than those reported by PHCC finance department due to the limited number of services included and the fact that our calculations focus solely on direct service delivery costs. Healthcare providers' annual salaries were obtained from the OneHealth Tool Costing Module[13] or the focal persons from the health ministry. When a clinical service not included in the initial list was added by the country, we estimated the drugs and supply costs and staff time requirements using data from the WHO-CHOICE database, WHO's review of vaccine price data[23], and relevant national reports or guidelines. The assumptions used in the model are presented in the supplemental materials (Supplemental Material 2 and 3).

Cost calculation model

We used an ingredient costing method to estimate the costs of a selection of services delivered at public PHC. This method consists of estimating the cost of producing a healthcare service by breaking down the total cost into the cost of individual ingredients or components, such as labour, equipment, materials, and supplies. In this analysis, the cost of one clinical service was calculated as follows: $TC=C_s x N_s$. Where TC is

the total cost, C_s is the cost per service, and N_s is the number of services delivered in one given year. The two components used in this formula are described below.

The cost per service was obtained as follows: Cs=DSc+Lc. Where DSc is the drugs and supply costs, and Lc is the labour cost. The labour cost was calculated by multiplying the number of minutes spent by each healthcare worker involved in delivering a service by their salary per minute. We estimated the salary per minute using staff time requirements from the OneHealth Tool Costing Module, as well as annual salaries and working time assumptions (working days per year, working hours per day) validated by the focal persons in each country. Using this approach, we only monetised the fraction of time directly employed on delivering the services. Therefore, we did not consider the time spent by the healthcare providers on non-clinical activities, such as training or coordination. Moreover, we accounted for overhead costs such as training, programme management, supervision, monitoring and evaluation, communication, infrastructure and equipment, transportation, and advocacy. Since there was no available information about the overhead costs necessary for running the selected services, an estimate equivalent to 20% of the total costs was agreed upon in consultation with the focal persons from the health ministry.

To determine the number of services delivered in a year, we primarily used data from the focal persons from the health ministry or obtained from annual health statistics reports. When the number of services delivered was unavailable, we used proxy indicators or estimates based on regional and international literature. When a coverage rate expressed in percentage was available, we estimated the corresponding number of services as follows: $N_s = TP_s \times PIN_s \times CR_s$. Where TP_s is the target population, PIN_s is the population in need, and CR_s is the coverage rate. The target population refers to the sub-population eligible for receiving a given service, and the population in need is the percentage of the target population who should receive a service in a year. The coverage rate refers to the percentage of the population in need who effectively received a service in the year. For example, if a population of 1,000,000 are eligible for receiving a service, that 50% of them must receive it in a year, but that the coverage rate is 70%, the number of services delivered was estimated at 350,000, calculated as follows: *350,000 = 1,000,000 x 0.50 x 0.70.*

Finally, when an indicator specified the number of individuals instead of the number of services delivered, we estimated the latter using treatment assumptions from the OneHealth Tool. For example, we assumed that an individual treated for an already established ischemic heart disease generated an average of six visits annually. The assumptions used in the model are presented in the supplemental materials (Supplemental Material 2 and 3).

Specific coverage rate estimation method

In this analysis, we also estimated the coverage rates for certain programmes (NCDs, mental health), disease types (diabetes, cardiovascular diseases, respiratory diseases), and intervention types (screening services). In this case, the coverage rates were calculated by dividing the aggregated number of individuals who received a set of selected services by the corresponding population in need. The results do not reflect the actual coverage rate at the country level since we did not consider the percentage of people who may have received similar services outside public PHC.

RESULTS

Cost of the selected primary healthcare services

The costs of the selected services delivered at the public PHC level across the six countries were estimated at US$5.7 billion in 2019. Table 1 presents the total costs for each country, as well as the cost per capita and the share of these costs in the current health expenditures (CHE) and government health expenditures (GHE). The highest cost per capita was observed in Kuwait (US$272.16), followed by Qatar (US$199.68). While KSA has the lowest per capita cost (US$68.60), the country has the highest overall cost, with an estimated US$2.3 billion in 2019.

Table 1. Cost of the selected clinical services*

	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
Total costs (US$, Million)	159.7	1,203.0	298.8	558.9	2,347.4	1,180.3
Per capita cost (US$)	107.62	272.16	112.55	199.68	68.60	120.83
Total costs (% of CHE)	10.3	16.3	9.6	12.7	5.2	6.6
Total costs (% of GHE)	24.2	18.6	10.9	17.0	8.3	11.8

* The costs presented in this table include the 20% increase for overhead costs
CHE = Current Health Expenditure, GHE= Government Health Expenditures

Costs distribution

Table 2 shows the distribution of the costs disaggregated by programme. The costs related to general practice were the most prominent in five of the six countries (52.7-77.0%), while in Qatar the NCDs programme made up the largest share of total costs (57.4%). In the five other countries, the share of the NCDs programmes varied from 6.9% in Bahrain to 19.8% in the UAE. The child health programme is another significant cost driver that accounts for between 4.2% (KSA) to 20.3% (Bahrain) of the total costs. Taken altogether, these three programmes represent 80.0-93.3% of the costs modelled in the six countries. The mental health programme had the lowest costs across all six countries, with between 0.0% (Bahrain, Oman) and 0.3% (UAE) of the costs modelled in the study.

Table 2. Cost of the selected clinical services disaggregated by programme in 2019 (US$, Million)*

	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
General practice	**77.7**	**610.4**	**130.5**	**109.1**	**1,445.7**	**497.1**
% of total costs	60.8	63.4	54.6	24.4	77.0	52.7
NCDs	**8.8**	**109.3**	**36.0**	**256.5**	**189.8**	**187.2**

% of total costs	6.9	11.4	15.1	57.4	10.1	19.8
Child health	**26.0**	**162.0**	**44.8**	**51.4**	**79.1**	**177.9**
% of total costs	20.3	16.8	18.7	11.5	4.2	18.8
Immunisation	**3.7**	**10.9**	**10.1**	**14.9**	**75.0**	**20.6**
% of total costs	2.9	1.1	4.2	3.3	4.0	2.2
Oral and dental care	**4.5**	**41.3**	**6.1**	**5.0**	**25.3**	**30.2**
% of total costs	3.6	4.3	2.5	1.1	1.3	3.2
Nutrition	**4.5**	**16.0**	**6.6**	**2.2**	**25.2**	**3.5**
% of total costs	3.5	1.7	2.8	0.5	1.3	0.4
RMCH	**2.5**	**11.8**	**5.0**	**7.7**	**36.5**	**25.1**
% of total costs	1.9	1.2	2.1	1.7	1.9	2.7
Mental health	**0.1**	**0.8**	**0.0**	**0.5**	**1.2**	**2.7**
% of total costs	<0.01	0.1	0.0	0.1	0.1	0.3
Total	**127.8**	**962.5**	**239.1**	**447.3**	**1,877.9**	**1,180.3**

* The costs presented in this table do not include the 20% increase for overhead costs

Non-communicable diseases

The costs of the clinical services related to diabetes, cardiovascular diseases and chronic respiratory diseases (asthma and chronic obstructive pulmonary diseases) were estimated at US$676 million in 2019 across all six countries. As these diseases are three of the major NCDs, we sought to understand the cost burden associated with managing and treating them. Based on the coverage rates and populations in need, we estimated that 14,911,170 individuals did not receive the services they needed at public PHC facilities in 2019.

Table 3. Cost of clinical services provided and estimated number of patients who did not receive services needed at the public PHC level for diabetes, cardiovascular and respiratory diseases

	Cost (US$, Million)*	% of total costs	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	5.03	3.9%	284,410
Kuwait	102.75	10.7%	947,920
Oman**	32.27	13.5%	376,910
Qatar***	254.44	56.9%	1,458,590
KSA	108.07	5.8%	9,950,800
UAE	173.16	18.3%	1,892,540
Total	675.72		14,911,170

* The costs presented in this table do not include the 20% increase for overhead costs

** Coverage rate was calculated considering Omani nationals only.
*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

NCD screening services

Table 4 shows the costs and coverage rates of seven NCD screening services (screening for risk of cardiovascular diseases and diabetes, clinical breast examination, pap smear, faecal occult blood test, and screening for diabetes complications). The total cost of these screening services across all six countries was estimated at US$18.1 million in 2019. In all countries, these costs account for less than 1% of the total costs modelled. Based on the coverage rates and populations in need, we estimated that 30,435,980 individuals did not receive the screening services they needed at public PHC facilities in 2019.

Table 4. Cost and coverage rate for services provided and estimated number of patients who did not receive services needed at the public PHC level for screening services

	Cost (Million, US$)*	% of total costs	Coverage rate (%)	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	0.9	0.7%	6%	1,058,870
Kuwait	1.1	0.1%	6%	3,184,360
Oman**	0.2	0.1%	7%	953,920
Qatar***	2.0	0.5%	4%	1,445,050
KSA	5.8	0.3%	5%	18,912,380
UAE	8.1	0.9%	5%	4,881,400
Total	**18.1**			**30,435,980**

* The costs presented in this table do not include the 20% increase for overhead costs
** Coverage rate was calculated considering Omani nationals only.
*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

Mental health services

The total cost of mental health services was estimated at US$5.3 million in 2019 across all six countries (Table 5). These costs made up between 0.0% (Bahrain, Oman) and 0.3% (UAE) of the total costs modelled. Based on the coverage rates and populations in need, we estimated that 8,724,160 individuals did not receive the mental services they needed at public PHC facilities in 2019.

Table 5. Cost and coverage rate for services provided and estimated number of patients who did not receive services needed at the public PHC level for mental health services

	Cost (Million, US$)*	% of total costs	Coverage rate (%)	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	0.1	0.0%	2%	206,090
Kuwait	0.8	0.1%	8%	267,310
Oman**	0.0	0.0%	0%	142,890
Qatar***	0.5	0.1%	2%	430,720
KSA	1.2	0.1%	1%	6,993,490
UAE	2.7	0.3%	4%	683,660
Total	**5.3**			8,724,160

* The costs presented in this table do not include the 20% increase for overhead costs

** Coverage rate was calculated considering Omani nationals only. Mental health services are not provided within primary care in Oman.

*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

DISCUSSION

This study aimed to estimate the cost of selected clinical services provided at public PHC facilities in the six countries of the GCC. The findings indicate that the cost of selected services across eight programmes (general practice, NCDs, child health, immunisation, oral and dental care, nutrition, reproductive, maternal, neonatal and child health, and mental health) exceeded US$5.7 billion in 2019. We observed significant variations in per capita cost, with KSA having the lowest (US$68) and Kuwait having the highest (US$217) cost. We attribute these variations to different reasons. Firstly, each country has a unique health system, which includes varying proportions of private care delivery and different healthcare delivery organisation. Secondly, the differences in population structure may also affect the costs of these services, with, for example, larger elderly populations requiring more costly services due to the higher prevalence of age-related chronic conditions. Lastly, these variations also result from differences in what interventions are delivered at the PHC level as opposed to other healthcare system levels, as well as coverage rates. While these factors demonstrate the complexity of comparing the cost of clinical services delivered at PHC facilities, this study allowed us to identify the main cost drivers and make recommendations.

Generally, the services classified under general practice were the main drivers of the total costs in all countries, followed by services related to preventing, treating, and managing NCDs. The large share of general practice in the total costs can be explained by the many services included within this programme. Costs of services related to NCDs are likely due to the high prevalence of these diseases, particularly diabetes, cardiovascular and respiratory diseases, in the six countries. A previous study found that NCDs killed nearly 43,000 people in the Gulf countries in 2019 and generated an economic burden estimated at around US$50 billion, equivalent to 3.3% of the GDP[24]. We also observed that the share of costs associated with these services is significantly higher in Qatar (57.4%) than in the five other countries, where it ranges from 6.9% to 19.8%. This factor could be attributed to Qatar being the only country where actual drugs and supplies costs were used in this analysis. Indeed, the actual unit costs provided by Qatar were significantly higher than those extracted from the OneHealth Tool, which were used for the remaining five countries. This suggests that the overall costs for these countries may have been underestimated. However, this could not be verified with the other countries.

The study estimated that approximately 15 million people did not receive necessary NCDs-associated services, and around 9 million people did not receive necessary mental health services at the public PHC level across all six countries in 2019. As the analysis only modelled the cost of services delivered at the public PHC level, individuals could have received these services in the private sector or at the secondary or tertiary level of the public sector. For example, around 67,000 mental health visits were recorded in Oman through extended healthcare centres in 2019[20], but none were included in our costing model.

We estimated that, across the six countries, around 30 million people did not receive the NCD screening services they required in public PHC. This includes screening for cardiovascular diseases, cervical, breast and colorectal cancers, diabetes and diabetes complications. Additionally, we found that the coverage rates for these seven services were consistently low across the countries, ranging from an average of 4% in Qatar to 7% in Oman. While these results show relatively low access to screening services, they should be qualified by the consideration that screening and awareness-related activities are rarely directly captured in health statistics records and health surveys, making them difficult to estimate accurately.

Limitations

This study had some limitations which must be considered when interpreting the results. Firstly, the list of services included in this study did not include all PHC services. Secondly, it is important to note that services included in the general practice programme could potentially overlap with other programmes. Challenges related to clearly delineating this programme in each of the six countries introduce uncertainty regarding the distribution of the costs per programme. Thirdly, the drugs and supply costs for each clinical service were estimated using cost assumptions from the OneHealth Tool Costing Module, except for Qatar where primary data was collected. Fourthly, service coverage data was not always available, which required making assumptions based on similar interventions or available data from neighbouring countries. The coverage rates must be interpreted with caution as they only reflect the number of services delivered at the public PHC level, and some services may also be delivered at other levels of the public health system and/or in the private sector. Moreover, without detailed information on the proportion of individuals utilising private care instead of public care, it becomes challenging to fully contextualise and evaluate the coverage rates. Fifthly, the study did not have information on overhead costs such as training, programme management, supervision, monitoring and evaluation, communication, infrastructure and equipment, transportation, and advocacy, and an estimation of 20% of the total costs was agreed upon to account for this. Finally, comparisons between countries and with other published estimates of PHC spending should be made with caution due to differences in the number and nature of the clinical services included for each country, variations in the healthcare system and population structure, and different data sources used.

Recommendations

The significance of robust PHC in establishing effective and efficient health systems is well acknowledged by all six GCC countries. They have made commendable strides in strengthening PHC by adapting to the evolving disease burden of their populations, as evident from the allocation of substantial costs to NCD services in this study. The comprehensive costing analysis presented in this report sheds light on specific areas where further enhancements in PHC services and resource allocation across the GCC countries can

be made. To reap substantial health and economic advantages, the following recommended actions deserve consideration:

1. **Strengthen the primary health workforce:** To address the shortage of skilled healthcare professionals in the primary care sector, the GCC countries should focus on increasing investment in training, attracting, and retaining local Family Physicians (FPs) and General Practitioners (GPs). This can be achieved through incentivising primary care training programmes, such as providing scholarships for nationals pursuing careers in primary care professions. Scaling up the primary health workforce will involve initial and ongoing training and remuneration costs, but the potential health and economic gains justify this investment.

2. **Expand NCD prevention and screening services:** Investing in disease prevention and routine screening services at the public PHC level is vital for strong PHC. The GCC countries have an opportunity to scale up their screening services for NCDs in public PHC, as over 30 million people in the region did not receive the required NCD screening services in 2019. To assess coverage fully, further research into private sector service provision and primary care coverage in the GCC countries is recommended. Scale-up of PHC services should be done with a focus on accessibility, equity, and achieving universal health coverage.

3. **Scale-up mental health services:** Despite progress in ensuring access to mental health services and reducing stigma, the majority of mental health services are still delivered at the secondary or tertiary level in the GCC region. Integrating mental health screening and care services into public PHC, especially in general practice, can improve accessibility and lead to better health outcomes compared to treatment at higher-level facilities. Scaling up mental health services at the PHC level aligns with a people-centered approach to PHC that addresses health and disease comprehensively.

4. **Enhance regional collaboration and policy coherence:** The GCC countries share common challenges and opportunities in strengthening PHC. Establishing a GCC PHC Coordination Committee with regular meetings to share best practices, lessons learned, and promote legislative action will support regional collaboration. The committee should focus on NCD prevention, screening, and treatment at the PHC level, and consider establishing a database to track progress and emerging challenges in NCD-related targets and indicators. Regional strategies and action plans should be developed to further promote policy coherence and collaboration.

5. **Invest in research and monitoring of PHC:** To improve the efficiency and health outcomes of PHC systems in the GCC region, there should be a focus on research and monitoring. Utilising the data

and costing model generated in the study, GCC countries can identify quick wins, as well as areas and services that require more resources or could be run more efficiently. Scaling up research and monitoring into PHC will provide a stronger evidence base and enable assessment of the impact of potential changes in PHC service delivery. Additionally, defining UHC health benefits packages will facilitate modelling costs associated with the included services.

By implementing these recommendations, the GCC countries can strengthen their PHC systems, leading to improved health outcomes and more efficient resource allocation. These actions will contribute to building effective and robust health systems that effectively address the changing disease burden of the population.

CONCLUSION

To our knowledge, this study is the first that aimed to estimate the costs of services delivered at PHC in the GCC countries. The findings indicate that general practice, child health, and NCDs, particularly diabetes, cardiovascular and respiratory diseases, were the main cost drivers. This study also shows that, in all countries, a significant number of individuals didn't receive essential services, such as screening for NCDs or mental health services, at the public PHC level. Based on these results, we recommend actions to increase the availability and accessibility of prevention and screening services, integrate mental health screening and care services into primary care, and expand research and monitoring efforts on PHC investment, both in the public and private sectors.

Abbreviations

FP	Family Physician
GCC	Gulf Cooperation Council
CHE	Current Health Expenditures
GHE	Government Health Expenditures
KSA	Kingdom of Saudi Arabia
PHC	Primary Healthcare
PHCC	Primary Healthcare Coorporation
NCD	Non-Communicable Disease
UAE	United Arab Emirates
UHC	Universal Health Coverage
WHO	World Health Organization

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Competing Interests

The authors declare no conflict of interest.

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Contributors

KE and SP substantially contributed to the conception, methodology development and data collection; conducted the data analysis, economic modelling and interpretation of data; and drafted the manuscript. DG, JJ, and RS substantially contributed to the conception and design, literature search, data collection, interpretation of data and drafting of the manuscript. TA, MM, LS, MA, ZA, SA, SF, HRS, and MA contributed to data collection and interpretation of data and revised the article critically for important intellectual content. LM, DA, YA, NB, and DT contributed to the conception and design, provided guidance on scope and interpretation of results, and revised the article critically for important intellectual content. KE, SP and DG are responsible for the overall content as guarantors. All authors approved the version of the manuscript to be published.

Ethics statements

Ethics approval was not required for this economic evaluation study. We used publicly accessible documents and data to conduct the economic analysis.

Patient and Public Involvement

In this economic evaluation study patients or the public were not involved in the design, conduct, reporting, or dissemination plans of our research

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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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Supplementary Materials

Table S1. List of selected services by country

Service	Bahrain	KSA	Kuwait	Oman	Qatar	UAE
Immunization						
Anti-rabies			X			
BCG vaccine	X	X	X	X	X	X
DPT vaccine	X		X	X	X	X
DT Adult			X			
DT paediatrics			X			
Heb B vaccine (paediatrics)			X			
Hep B vaccine	X				X	X
Hib vaccine	X				X	X
HPV vaccine		X				X
Influenza vaccine	X		X		X	X
Measles vaccine	X	X	X	X	X	X
Meningococcal vaccine			X			
Pentavalent vaccine		X	X	X		
Pneumococcal vaccine	X	X	X	X	X	X
Polio vaccine	X	X	X	X	X	X
Rotavirus vaccine	X		X		X	X
Rubella vaccine		X				
TT			X			
Varicella vaccine	X	X	X	X	X	
Non-Communicable Diseases						
Breast Cancer						
Basic breast cancer awareness	X	X	X	X	X	X
Diagnosis after screened with clinical breast exam			X	X		X
Diagnosis after screened with mammography						X
Diagnosis without screening for breast cancer						X
Diagnosis: screened with clinical breast exam		X				

Diagnosis: screened with mammogram		X				
Post-treatment surveillance for breast cancer patients		X				
Screening: clinical breast examination	X	X	X	X	X	X
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Screening: mammography		X				X
Cervical Cancer						
HPV DNA + VIA						X
Papanicolaou test (pap smear)	X	X	X	X	X	X
Post-treatment surveillance for cervical cancer		X				
Visual inspection with acetic acid (VIA)						X
Colorectal Cancer						
Diagnosis for colorectal cancer screened with FIT						X
Diagnosis for colorectal cancer screened with FOBT		X				X
Diagnosis without screening for colorectal cancer (symptom based)		X				X
Post-treatment surveillance for colorectal cancer		X				
Screening: colonoscopy		X				
Screening: faecal immunochemical test						X
Screening: faecal occult blood testing	X	X	X	X	X	X
Screening: sigmoidoscopy		X				
CVD & Diabetes						
Follow-up care for those at low risk of CVD/Diabetes (absolute Risk: 10-20%)	X	X	X	X	X	X
Intensive glycaemic control	X	X	X	X	X	X
Neuropathy screening and preventive foot care	X	X	X	X	X	X
Referral for retinopathy screening				X		
Retinopathy screening	X		X		X	X
Screening for risk of CVD/Diabetes	X	X	X	X	X	X
Standard glycaemic control	X	X	X	X	X	X
Treatment for those with absolute risk of CVD/Diabetes 20-30%	X	X	X	X	X	X
Treatment for those with established cerebrovascular disease and post stroke	X	X	X	X	X	X
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	X	X	X	X	X	X
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	X	X	X	X	X	X
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	X	X	X	X	X	X
Treatment of cases with established ischaemic heart disease (IHD)	X	X	X	X	X	X
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	X	X			X	X
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	X	X	X	X	X	X
Emergency care						
Average annual emergency care needs	X	X	X	X	X	X
Oral Care						

Dental cleaning and preventive care	X	X	X	X	X	
Oral and dental care						X
Respiratory Diseases						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Asthma: high dose inhaled beclomethasone + SABA	X		X		X	X
Asthma: high dose inhaled fluticasone + SABA		X		X		
Asthma: inhaled short acting beta agonist for intermittent asthma	X	X	X	X	X	X
Asthma: low dose inhaled beclomethasone + SABA	X		X		X	X
Asthma: low dose inhaled fluticasone + SABA		X		X		
Asthma: oral prednisolone + theophylline + high dose inhaled fluticasone + SABA		X		X		
Asthma: theophylline + high dose inhaled fluticasone + SABA		X		X		
COPD: exacerbation treatment with antibiotics	X	X	X	X	X	X
COPD: exacerbation treatment with oral prednisolone	X	X	X	X	X	X
COPD: exacerbation treatment with oxygen		X		X		X
COPD: inhaled salbutamol	X	X	X	X	X	X
COPD: ipratropium inhaler	X	X	X	X	X	X
COPD: low-dose oral theophylline	X	X	X	X	X	
COPD: smoking cessation	X	X	X	X	X	X
Child Health						
Deworming						
Deworming	X		X	X	X	
Diarrhea management						
Antibiotics for treatment of dysentery		X		X		X
ORS	X	X	X	X	X	X
Treatment of severe diarrhea		X				
Zinc (diarrhea treatment)		X		X		
General						
Zinc supplementation		X		X		
Child general health	X	X	X	X	X	X
School health	X				X	
Malaria						
Malaria treatment (0-4, mild cases)				X		
Pneumonia						
Pneumonia treatment (children)	X	X	X	X	X	X
Treatment of severe pneumonia		X				
Routine Child Health Care Visit						
Routine child health care visit (< 1 year)						X
Routine child health care visit (1-5 years)						X
School Health Program						

Dental screening				X		
Ear screening				X		
Eye screening				X		
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Nutrition						
Adults						
Care for adults with food allergies and sensitivities						X
Care for adults with hyperuricemia						X
Care for adults with kidney diseases						X
Care for adults with low BMI	X	X	X	X	X	
Care for adults with nutritional anaemia						X
Care for adults with other nutritional diseases						
Care for diabetic adults						X
Care for obese adults						X
All populations						
Food fortification						X
Children						
Breastfeeding counselling and support	X	X	X	X	X	
Complementary feeding counselling and support	X	X	X	X		
Feeding counselling and support for infants and young children in emergency situations						
Intermittent iron supplementation in children	X		X	X	X	
Management of food allergies or food intolerances						X
Management of moderate acute malnutrition						X
Management of moderate acute malnutrition (children)		X		X		
Management of severe malnutrition						X
Pregnant and lactating women						
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia				X		
Daily FAF, postpartum, anaemic women				X		
Daily iron and folic acid supplementation (pregnant women)	X	X	X	X	X	
Intermittent FAF, postpartum, non-anaemic pregnant women				X		
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	X	X	X	X	X	
Iodine supplementation in pregnant women		X				
Vitamin A supplementation in pregnant women		X				
Women of reproductive age and adolescent girls						
Intermittent iron-folic acid supplementation	X	X	X	X	X	
Mental Health						
Alcohol use/ dependence						
Identification and assessment of new cases of alcohol use/dependence				X		X

Brief interventions and follow-up for alcohol use/dependence		X		X		
Identification and assessment of new cases of alcohol use/dependence		X				
Anxiety Disorders						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Basic psychological treatment for anxiety disorders (mild cases).	X		X	X	X	X
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (mild-moderate cases)	X	X	X		X	X
Basic psychosocial treatment for anxiety disorders (mild cases)		X				
Attention Disorders						
Methylphenidate medication						X
Bipolar Disorders						
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication		X				X
Conduct Disorders						
Basic psychosocial treatment, advice, and follow-up for behavioural disorders		X				X
Dementia						
Assessment, diagnosis, advice, and follow-up for dementia		X				X
Dementia screening, basic work up and referral to tertiary care				X		
Pharmacological treatment of dementia						X
Depression						
Basic psychosocial treatment and anti-depressant medication of first episode (mild to moderate cases)				X		
Basic psychosocial treatment and anti-depressant medication of first episode (moderate-severe cases)	X	X	X		X	X
Basic psychosocial treatment for mild depression	X	X	X	X	X	X
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis						X
Psychosocial care for perinatal depression						X
Psychosocial care for perinatal depression for mild cases only				X		
Developmental Disorders						
Basic psychosocial treatment, advice, and follow-up for developmental disorders		X				X
Drug use/dependence						
Brief interventions and follow-up for drug use/dependence		X		X		X
Identification and assessment of new cases of drug use/dependence		X		X		
Epilepsy						
Basic psychosocial support, advice, and follow-up only				X		
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication		X				X
Psychosis						
Basic psychosocial support and anti-psychotic medication		X		X		X
Self-harm/suicide						
Assess and care for person with self-harm		X		X		

Basic psychosocial treatment, advice, and follow-up for self-harm/suicide				X		
Pesticide intoxication management				X		
Maternal Newborn and Reproductive Health						
Antenatal Care (ANC)						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Antenatal Care (ANC)						X
Childbirth care - Facility births						
Feeding counselling and support for low-birth-weight infants				X		
Kangaroo mother care				X		
Labour and delivery management				X		
Manual removal of placenta				X		
MgSO4 for eclampsia				X		
Neonatal resuscitation				X		
Parenteral administration of uterotonics				X		
Pre-referral management of labour complications		X		X		
Treatment of local infections (newborn)				X		
Family planning						
Condom - male				X		
Contraception management					X	
Implant - Implanon (3 years)				X		
Injectable - 3 month (depo provera)	X		X	X		
IUCD follow-up care	X		X		X	
IUD - Copper-T 380-A IUD (10 years)		X		X		
Lactational amenorrhea method				X		
Other contraceptives	X		X			
Periodic abstinence				X		
Pill - progestin only	X		X	X		
Pill - standard daily regimen		X				
Standard days method				X		
Withdrawal		X		X		
Post-abortion case management			X		X	
Management of ectopic pregnancy care						
Ectopic case management				X		
Menopause Program						
Screen for mood disorders				X		
Screen for urogenital dryness				X		
Other						
Postmenopausal care			X			
Management of abnormal uterine bleeding			X			

Management of amenorrhea			X			
Management of hirsutism			X			
Management of irregular cycles			X			
Management of mild endometriosis			X			
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Management of PCO			X			
Management of pre pubertal problems (delayed menarche, infection)			X			
Other sexual and reproductive health						
Cervical cancer screening		X	X			
Identification and management of infertility	X	X	X	X	X	
Treatment of chlamydia	X	X	X	X	X	
Treatment of gonorrhoea	X	X	X	X	X	
Treatment of pelvic inflammatory disease	X	X	X	X	X	
Treatment of syphilis	X	X	X	X	X	
Treatment of trichomoniasis	X	X	X	X	X	
Treatment of urinary tract infection	X	X	X	X	X	
Postpartum Care						
Breast feeding education and advice	X		X		X	
Mastitis	X		X	X		
Postnatal care						X
Postpartum care examination					X	
Treatment of postpartum haemorrhage	X	X	X	X	X	
Maternal sepsis case management				X		
Preconception Care (PCC)						
Preconception care						X
Pregnancy Care						
Basic ANC	X	X	X	X	X	
Syphilis detection and treatment (pregnant women)	X		X		X	
Tetanus toxoid (pregnant women)	X	X	X	X	X	
Syphilis screening (pregnant women)				X		
Pregnancy care - Treatment of pregnancy complications						
Deworming (pregnant women)	X		X	X		
Hypertensive disorder case management		X		X		
Management of other pregnancy complications				X		
Management of pre-eclampsia (magnesium sulphate)				X		
Premarital screening program						
Premarital screening program						X
General Practice						
General practice	X	X	X	X	X	X

Table S2. Assumptions used to estimate the population in need, drugs and supplies costs, and labour costs (all countries)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Varicella vaccine	Children 1 and 5 years old, for the first and the second dose	USD 17.5 for one dose (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Influenza vaccine	Children 0-5 + Pregnant women + People 65+	USD 2.39 for one dose (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Retinopathy screening	People with diabetes should be screened every year (100%)	-	-
Neuropathy screening	People with diabetes should be screened every year (100%)	-	-
Clinical breast examination	Women aged 40-70 should be screened every 2 years (50%)	-	-
Diagnosis after screened with clinical breast examination	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Pap smear	Women 30-49 should be screened every 3 years (33%)	-	-
Faecal occult blood screening	People 50+ should be screened every 10 years (10%)	-	-
Dental cleaning and preventive care	All population	No costs estimated	Nurse (20 min) and Dentist (15 min) for one visit
General child health	Children 0-14	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
Pneumonia treatment	-	-	Nurse (20 min) + GP (20 min) for one visit
Daily iron and folic acid supplementation (anaemic pregnant women)	100% of anaemic pregnant women (World Bank)	-	-
Intermittent iron folic acid supplementation (non-anaemic pregnant women)	100% of non-anaemic pregnant women (World Bank)	-	-
Daily FAF, postpartum, non-anaemic women	Based on number of live births (Annual Health Statistics) and percentage of anaemic women (World Bank)		

Intermittent FAF, postpartum, anaemic women	Based on number of live births (Annual Health Statistics) and percentage of non-anaemic women (World Bank)		
Care for adults with low BMI	100% of underweight adults (Global Nutrition Report)	-	-
All mental health clinical services	Based on prevalence rates (Zuberi et al. 2021, GBD 2016 Epilepsy Collaborators, GBD 2016 Dementia Collaborators, WHO-EMRO, Atlas of Substance Disorder).	-	-
Treatment of postpartum haemorrhage (PPH)	Based on incidence rates of PPH	-	-
Identification and management of infertility	Based on regional prevalence (Eldib 2018) among adults 15-49 (3.8%)	-	-
Treatment of syphilis	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (2.2%)	-	-
Treatment of gonorrhoea	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (0.9%)	-	-
Treatment of chlamydia	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (1.9%)	-	-
Treatment of trichomoniasis	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (2.8%)	-	-
Treatment of pelvic inflammatory infection	Based on US incidence rate (Kresiel 2021) among adults 15-49 (3.6%)	-	-
General practice	All population	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
All Services	-	-	Community health workers time was allocated to nurses

Table S2-A. Country-specific assumptions (Oman)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
School health program (eye screening)	Children in grade 1, 4, 7 and 10	No costs estimated	Nurse (10 min) for one visit
School health program (dental screening)	Children in grade 1	No costs estimated	Nurse (10 min) for one visit

School health program (ear screening)	Children in grade 1 and 2	No costs estimated	Nurse (10 min) for one visit
Menopause program: screen for urogenital dryness, screen for mood disorders	Women 45-55 (100%)	No costs estimated	GP (15 min) for one visit
Elderly and community care program	People 60+	No costs estimated	Nurse (45 min) for one visit

Table S2-B. Country-specific assumptions (Bahrain)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
School health	Children 5-19	No costs estimated	Nurse (10 min) for one visit

Table S2-C. Country-specific assumptions (Kuwait)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Meningococcal vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 10.6 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
DT adult vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 1.8 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
DT pediatrics vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 1.8 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Anti-rabies vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 48.6 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Hep B vaccine (paediatrics)	PIN was not estimated since the number of visits was directly provided by MOH	USD 3.24 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
TT vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 0.58 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Management of pre-pubertal problems	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Obs/Gyn (15 min) for one visit
Management of PCO, hirsutism, irregular cycles, amenorrhea, abnormal uterine bleeding, management of mild endometriosis, postmenopausal care	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Obs/Gyn (15 min) for one visit

Table S2-D. Country-specific assumptions (Qatar)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Child General Health	Children 0-14	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
School health	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Nurse (10 min) for one visit
Postpartum care examination	PIN was not estimated since the number of visits was directly provided by MOH	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (10 min) and Midwife (20 min) for one visit
Allied health	PIN was not estimated since the number of visits was directly provided by MOH	Cost per outpatient visit (WHO-CHOICE) – Labour costs	Nurse (20 min) for one visit

Table S2-E. Country-specific assumptions (UAE)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Screening: mammography	Women aged 40-70 should be screened every 2 years (50%)	-	-
Diagnosis for breast cancer	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Visual inspection with acetic acid, HPV DNA + VIA.	Based on country cervix cancer incidence rate (WHO – IARC 2020)	-	-
Screening; faecal immunochemical test	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-
Diagnosis for colorectal cancer	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-
Routine child healthcare visit (1 year)	Children 0-12 months (100%)	Estimate based on OHT drugs and supplies prices: USD 19.7	Nurse (20 min), GP (10 min)
Routine child healthcare visit (1-5 years)	Children 12-59 months (100%)	Estimate based on OHT drugs and supplies prices: USD 2.8	Nurse (20 min), GP (10 min)
Nutrition: Care for obese adults	People with obesity (Global Nutrition Report)	No costs estimated	GP (10 min)
Nutrition: Care for diabetic adults	People with diabetes (OHT)	No costs estimated	GP (10 min)

Nutrition: Care for adults with kidney diseases	Adults with chronic kidney disease (Al-Shamsi et al. 2018)	No costs estimated	GP (10 min)
Nutrition: Care for adults with nutritional anaemia	Adults with anaemia (Global Nutrition Report)	No costs estimated	GP (10 min)
Nutrition: Care for adults with food allergies and sensitivities	People with nutrition-related allergies (Althumiri et al. 2021)	No costs estimated	GP (10 min), Specialist Doctor (30 min)
Management of food allergies and food intolerance	Children 0-14 x Global Prevalence of Allergies (3.0%)	No costs estimated	GP (10 min), Specialist Doctor (30 min)
Preconception care	Married women or planning for marriage at reproductive age (15-49 years)	Estimate based on OHT drugs and supplies prices: USD 4.90	Nurse (15 min), GP (15 min)
Antenatal care	Pregnant women	Estimate based on OHT drugs and supplies prices: USD 36.42	GP (40 min), Radiographer (20 min), Midwife (40 min)
Postnatal care	Women who gave birth	No costs estimated	Nurse (15 min), GP (15 min)
Premarital screening program	Women (15-49) planning for a marriage	Estimate based on OHT drugs and supplies prices: USD 15.66	Nurse (15 min), GP (15 min)

Table S2-F. Country-specific assumptions (KSA)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Screening: mammography	Women aged 40-70 should be screened every 2 years (50%)	-	-
Post-treatment surveillance for breast cancer patients	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Post treatment surveillance for cervical cancer	Based on country cervix cancer incidence rate (WHO – IARC 2020)	-	-
Screening: Sigmoidoscopy, colonoscopy	People 50+ should be screened every 10 years (10%)	-	-
Post treatment surveillance for colorectal cancer	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-

Table S3. References and assumptions used to estimate the total number of services delivered in 2019 in Oman

Immunization	Reference / Assumption
Measles vaccine	MOH Health Statistics 2019[1]
Pentavalent vaccine	
Varicella vaccine	
DPT vaccination	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs[2]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[1]
Intensive glycaemic control	
Referral for retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: clinical breast examination (CBE)	MOH Health Statistics[1]
Diagnosis after screened with clinical breast exam	Assumption derived from WHO-IARC 2020[3]
Cervical Cancer	
Papanicolaou test (pap smear)	Assumption derived from Bahrain CR
Colorectal Cancer	
Screening: faecal occult blood testing	Assumption derived from 'CBE'
Elderly and community care program	
Elderly and community care program	MOH Health Statistics 2019[1]
Respiratory Disease	

Asthma: Inhaled short acting beta agonist for intermittent asthma	MOH Health Statistics 2019[1]
Asthma: Low dose inhaled fluticasone + SABA	
Asthma: High dose inhaled fluticasone + SABA	
Asthma: Theophylline + High dose inhaled fluticasone + SABA	
Asthma: Oral Prednisolone + Theophylline + High dose inhaled fluticasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: Exacerbation treatment with antibiotics	
COPD: Exacerbation treatment with oral prednisolone	
COPD: Exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General	
Child general health	Assumption: 25% of GP visits (MOH Health Statistics 2019[1])
Deworming	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc supplementation	
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc (diarrhea treatment)	
Antibiotics for treatment of dysentery	
Pneumonia	
Pneumonia treatment (children, mild cases)	Estimate from MOH Health Statistics 2019[1]
Malaria	
Malaria treatment (0-4, mild cases)	Estimate from MOH Health Statistics 2019[1]
School Health Program	
Eye screening	MOH Health Statistics 2019[1]
Dental screening	
Ear screening	
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 5%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from MOH Health Statistics 2019[1]

Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia	
Daily FAF, postpartum, anaemic women	Estimate from MOH Health Statistics 2019[1]
Intermittent FAF, postpartum, non-anaemic pregnant women	
Adults	
Care for adults with low BMI	Assumption: 2.5%
Children	
Breastfeeding counselling and support	MOH Health Statistics 2019[1]
Complementary feeding counselling and support	Assumption derived from UHC Service Coverage Index (WHO)[2]
Intermittent iron supplementation in children	
Management of moderate acute malnutrition (children)	MOH Health Statistics 2019[1]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (mild to moderate cases)	
Depression	
Basic psychosocial treatment for mild depression	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment and anti-depressant medication of first episode (mild to moderate cases)	
Psychosocial care for peri-natal depression for mild cases only	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Estimate from MOH Health Statistics 2019[1]
Epilepsy	
Basic psychosocial support, advice, and follow-up only	Estimate from MOH Health Statistics 2019[1]
Dementia	
Dementia screening, basic work up and referral to tertiary care	Estimate from MOH Health Statistics 2019[1]
Alcohol use/ dependence	
Identification and assessment of new cases of alcohol use/dependence	Estimate from MOH Health Statistics 2019[1]
Brief interventions and follow-up for alcohol use/dependence	
Drug use/dependence	
Identification and assessment of new cases of drug use/dependence	Estimate from MOH Health Statistics 2019[1]
Brief interventions and follow-up for drug use/dependence	
Self-harm/suicide	
Assess and care for person with self-harm	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment, advice, and follow-up for self-harm/suicide	
Pesticide intoxication management	
Maternal Newborn and Reproductive Health	

Family planning	
Pill - Progestin only	MOH Health Statistics 2019[1]
Condom - Male	
Injectable - 3 month (Depo Provera)	
IUD - Copper-T 380-A IUD (10 years)	
Implant - Implanon (3 years)	Assumption: 0.5%
LAM (Lactational Amenorrhea Method)	MOH Health Statistics 2019[1]
SDM (Standard Days Method)	
Periodic abstinence	
Withdrawal	
Management of ectopic pregnancy care	
Ectopic case management	Assumption: 100%
Pregnancy care - ANC	
Tetanus toxoid (pregnant women)	Estimate from MOH Health Statistics 2019[1]
Syphilis screening (pregnant women)	MOH Health Statistics 2019[1]
Basic ANC	
Pregnancy care - Treatment of pregnancy complications	
Hypertensive disorder case management	Assumption: 99%
Management of pre-eclampsia (Magnesium sulphate)	
Management of other pregnancy complications	
Deworming (pregnant women), part of general care and not specific for pregnant women	Assumption derived from UHC Service Coverage Sub-Index on RMNH (WHO)[2]
Childbirth care - Facility births	
Parenteral administration of uterotonics	Estimate from MOH Health Statistics 2019[1]
Labour and delivery management	
Pre-referral management of labour complications	
MgSO4 for eclampsia	
Neonatal resuscitation	
Treatment of local infections (newborn)	
Kangaroo mother care	
Feeding counselling and support for low-birth-weight infants	
Manual removal of placenta	
Postpartum care - Treatment of sepsis	
Maternal sepsis case management	Estimate from MOH Health Statistics 2019[1]
Postpartum care - Other	
Mastitis	Estimate from UHC Service Coverage Sub-Index on RMNH (WHO)[2]
Treatment of postpartum haemorrhage	Assumption: 100%

Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	MOH Health Statistics 2019[1]
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)- mild cases only	
Menopause Program	
Screen for urogenital dryness	Assumption: 7.5%
Screen for mood disorders	Assumption: 7.5%
General Practice	
General Practice	Estimate from MOH Health Statistics 2019[1]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[1]

Table S4. References and assumptions used to estimate the total number of services delivered in 2019 in Bahrain

Immunization	
Rotavirus vaccine	MOH Health Statistics 2019[4]
Measles vaccine	
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	Estimate from MOH Health Statistics 2019[4]
Influenza vaccine	MOH Health Statistics 2019[4]
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Estimate from MOH Health Statistics 2019[4]
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	

Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[4]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: clinical breast examination (CBE)	MOH Health Statistics 2019[4]
Cervical Cancer	
Papanicolaou test (pap smear)	MOH Health Statistics 2019[4]
Colorectal Cancer	
Screening: faecal occult blood testing	Estimate from 'CBE' and 'pap smear'
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Asthma: low dose inhaled beclomethasone + SABA	
Asthma: high dose inhaled beclomethasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General Health	
Child general health	Assumption: 25% of total number of GP Visit (MOH Health Statistics 2019[4])
School Health	
School Health	MOH Health Statistics 2019[4]
Deworming	
Deworming	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Diarrhea management	

ORS	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 5.0%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Estimate from MOH Health Statistics 2019[4]
Children	
Breastfeeding counselling and support	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Complementary feeding counselling and support	
Intermittent iron supplementation in children	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	Estimate from MOH Health Statistics 2019[4]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	Estimate from MOH Health Statistics 2019[4]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Pill - Progestin only	United Nations 2019[5]
Injectable - 3 month (Depo Provera)	
Other contraceptives	
IUCD follow-up care	Assumption derived from UHC Service Coverage Index (WHO)[2]
Pregnancy Care	
Tetanus toxoid (pregnant women)	Estimate from MOH Health Statistics 2019[4]
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Pregnancy care - Treatment of pregnancy complications	
Deworming (pregnant women)	Assumption: 100%
Postpartum care - Other	

Mastitis	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Breast feeding education and advices	
Treatment of postpartum haemorrhage	Assumption: 100%
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	MOH Health Statistics 2019[4]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[4]

Table S5. References and assumptions used to estimate the total number of services delivered in 2019 in Kuwait

Immunization	
Rotavirus vaccine	MOH Health Statistics 2019[6]
Measles vaccine	
Pentavalent vaccine	
DPT vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	
DT Adult	
Measles vaccine	Provided by MOH
Varicella vaccine	
Influenza vaccine	
Meningococcal vaccine	
DT paediatrics	
Anti-Rabies	
Heb B vaccine (paediatrics)	
TT	

Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: CR = 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	Provided by MOH
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[6]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: CR = 5.0%
Screening: clinical breast examination	Assumption derived from Oman
Diagnosis after screened with clinical breast exam	Estimate from WHO-IARC 2020[3]
Cervical Cancer	
Papanicolaou test (pap smear)	Provided by MOH
Colorectal Cancer	
Screening: faecal occult blood testing	Provided by MOH
Respiratory Disease	
Asthma: inhaled short acting beta agonist for intermittent asthma	Estimation from data provided by MOH
Asthma: low dose inhaled beclomethasone + SABA	
Asthma: high dose inhaled beclomethasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	

General Health	
Child general health	MOH Health Statistics 2019[6]
Deworming	
Deworming	Provided by MOH
Diarrhea management	
ORS	Estimate based on data provided by MOH
Pneumonia	
Pneumonia treatment (children)	Provided by MOH
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Estimate from data provided by MOH
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Assumption derived from UHC Service Coverage Sub-Index on MRCH (WHO)[2]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Assumption derived from Bahrain
Children	
Breastfeeding counselling and support	Assumption derived from UHC Service Coverage Sub-Index on MRCH (WHO)[2]
Complementary feeding counselling and support	
Intermittent iron supplementation in children	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	OneHealth Tool[7]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	OneHealth Tool[7]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Pill - Progestin only	United Nations 2019[5]
Injectable - 3 month (depo provera)	
Other contraceptives	
IUCD follow-up care	Assumption derived from UHC Service Coverage Index (WHO)[2]
Management of abortion complications	
Post-abortion case management	Assumption (70.0%)
Pregnancy Care	

Tetanus toxoid (pregnant women)	Estimate based on data provided by MOH.
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Pregnancy care - Treatment of pregnancy complications	
Deworming (pregnant women)	Assumption (100.0%)
Postpartum care - Other	
Mastitis	Assumption derived from UHC Service Coverage Index (WHO)[2]
Breast feeding education and advices	
Treatment of postpartum haemorrhage	Estimate based on data provided by MOH.
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Provided by MOH
Cervical cancer screening	
Identification and management of infertility	
Treatment of syphilis	Estimate based on data provided by MOH
Treatment of gonorrhea	Provided by MOH
Treatment of chlamydia	Estimate based on data provided by MOH
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	Provided by MOH
Other	
Management of pre pubertal problems	Provided by MOH
Management of PCO	
Management of hirsutism	Estimate based on data provided by MOH
Management of irregular cycles	Provided by MOH
Management of amenorrhea	
Management of abnormal uterine bleeding	
Management of mild endometriosis	
Postmenopausal care	
General Practice	
General Practice	MOH Health Statistics 2019[6]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[6]

Table S6. References and assumptions used to estimate the total number of services delivered in 2019 in Qatar

Immunization	
Rotavirus vaccine	Global Health Observatory (WHO)[2]
Measles vaccine	Qatar Health Statistics 2019[8]
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	Estimate from Qatar Health Statistics 2019[8]
Influenza vaccine	Assumption derived from GCC countries
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Estimate from PHCC Official Statistics
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	
Intensive glycaemic control	
Retinopathy screening	Assumption: 1%
Neuropathy screening and preventive foot care	Assumption: 1%
Breast Cancer	
Basic breast cancer awareness	Assumption: 5%
Screening: Clinical Breast Examination	Assumption derived from GCC countries and PHCC Official Statistics
Cervical Cancer	
Papanicolaou test (Pap smear)	Assumption derived from GCC countries and PHCC Official Statistics
Colorectal Cancer	
Screening: Fecal occult blood testing	Assumption derived from GCC countries and PHCC Official Statistics
Allied Health	
Allied Health	PHCC Official Statistics

Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	PHCC Official Statistics
Asthma: Low dose inhaled beclomethasone + SABA	
Asthma: High dose inhaled beclomethasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Low-dose oral theophylline	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General Health	
Child General Health	Estimate from PHCC Official Statistics
General Health	
School Health	PHCC Official Statistics
Deworming	
Deworming	PHCC Official Statistics
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index for Infectious Diseases[2]
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Index for Infectious Diseases[2]
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 50%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from data provided by PHCC Official Statistics and World Bank[9]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Assumption: 2.5%
Children	
Breastfeeding counselling and support	Assumption: 70%
Intermittent iron supplementation in children	Assumption derived from Zainel et al. (2018)[10]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	PHCC Official Statistics
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	

Basic psychosocial treatment for mild depression	PHCC Official Statistics
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Contraception Management	Estimate from PHCC Official Statistics
Management of abortion complications	
Post-abortion case management	Estimate from PHCC Official Statistics
Pregnancy Care	
Tetanus toxoid (pregnant women)	Estimate from PHCC Official Statistics
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Postpartum care - Other	
Postpartum Care Examination	PHCC Official Statistics
Treatment of postpartum haemorrhage	
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	PHCC Official Statistics
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	PHCC Official Statistics
Oral Care and Cancer	
Dental cleaning and preventive care	PHCC Official Statistics

Table S7. References and assumptions used to estimate the total number of services delivered in 2019 in UAE

Immunization	
Rotavirus vaccine	WHO-UNICEF Estimates 2019[11]
Measles vaccine	
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	

HPV vaccine	HPV Information Centre[12]
Influenza vaccine	Assumption derived from Bahrain
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	Estimate from OneHealth Tool[7] and Dubai Government Annual Health Statistics Book 2019[13]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: Clinical Breast Examination	Estimate from Bahrain
Screening: Mammography	Assumption: 0.9%
Diagnosis after Screened with Clinical Breast Exam	Estimation from WHO IARC 2020[3]
Diagnosis after Screened with Mammography	
Diagnosis without screening for breast cancer	
Cervical Cancer	
Visual inspection with acetic acid (VIA)	Assumption: 5.0%
Papanicolaou test (Pap smear)	Assumption: 9.3%
HPV DNA + VIA	Assumption: 5.0%
Colorectal Cancer	
Screening: faecal immunochemical test	Assumption : 0.5%
Screening: faecal occult blood testing	
Diagnosis for colorectal cancer screened with FIT	Assumption: 100%
Diagnosis for colorectal cancer screened with FOBT	
Diagnosis without screening for colorectal cancer (symptom based)	
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[3]
Asthma: Low dose inhaled beclomethasone + SABA	

Asthma: High dose inhaled beclomethasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
COPD: exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Oral Care	
Oral and dental care	Estimate from Dubai Government Annual Health Statistics Book[13]
Child Health	
General Health (Children)	
General Health (Children)	Assumption: 25% of GP visits
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Antibiotics for treatment of dysentery	
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Routine Child Health Care Visit	
Routine Child Health Care Visit (< 1 year)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Routine Child Health Care Visit (1-5 years)	
Nutrition	
Adults	
Care for Obese adults	Assumption: 5.0%
Care for Diabetic adults	
Care for adults with hyperuricemia	
Care for adults with kidney diseases	
Care for adults with nutritional anaemia	
Care for adults with food allergies and sensitivities	
All populations	
Food fortification	Assumption: 100%
Children	
Management of severe malnutrition	Assumption derived from UHC Service Coverage Index (WHO)[2]
Management of moderate acute malnutrition	
Management of Food allergies or Food intolerances	Assumption: 5.0%
Mental Health	
Anxiety Disorders	
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	Estimate from Abu Dhabi Government Annual Health Statistics[14]

Basic psychological treatment for anxiety disorders (mild cases).	
Depression	
Basic psychosocial treatment for mild depression	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis	
Psychological care for peri-natal	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Bipolar Disorders	
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Epilepsy	
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Developmental Disorders	
Basic psychosocial treatment, advice, and follow-up for developmental disorders	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Conduct Disorders	
Basic psychosocial treatment, advice, and follow-up for behavioural disorders	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Attention Disorders	
Methylphenidate medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Dementia	
Assessment, diagnosis, advice, and follow-up for dementia	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Pharmacological treatment of dementia	
Alcohol Use/Dependence	
Identification and assessment of new cases of alcohol use/dependence	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Drug Use/Dependence	
Brief interventions and follow-up for drug use/dependence	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Maternal Newborn and Reproductive Health	
Preconception Care (PCC)	
Preconception Care (PCC)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Antenatal Care (ANC)	
Antenatal Care (ANC)	Assumption: 99% ANC Coverage
Postnatal Care (PNC)	
Postnatal Care (PNC)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Premarital screening program	
Premarital screening program	Assumption: 100%
General Practice	
General Practice	Estimate from Dubai Government Annual Health Statistics Book[13]

Table S8. References and assumptions used to estimate the total number of services delivered in 2019 in KSA

Immunization	
Measles vaccine	MOH Statistical Yearbook 2019[15]
Pentavalent vaccine	
Varicella vaccine	Estimate from MOH Statistical Yearbook 2019[15]
Polio vaccine	MOH Statistical Yearbook 2019[15]
BCG vaccine	
Rubella vaccine	
Pneumococcal vaccine	
HPV vaccine	Assumption: 5.0%
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Estimate from MOH Statistical Yearbook 2019[15]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	KSA World Health Survey[16]
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Standard glycaemic control	Estimate from MOH Statistical Yearbook 2019[15]
Intensive glycaemic control	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: Clinical Breast Examination	Assumption derived from Bahrain
Screening: Mammography	KSA World Health Survey[16]
Diagnosis: Screened with clinical breast exam	Estimate from WHO IARC 2020[3]
Diagnosis: Screened with mammogram	
Post-treatment surveillance for breast cancer patients	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Cervical Cancer	
Papanicolaou test (Pap smear)	KSA World Health Survey[16]
Post treatment surveillance for cervical cancer	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Colorectal Cancer	

Screening: faecal occult blood testing	Estimate from Aljumah and Aljebreen (2017)[17]
Screening: Sigmoidoscopy	
Screening: Colonoscopy	
Diagnosis for colorectal cancer screened with FOBT	Estimation from WHO IARC 2020[3]
Diagnosis without screening for colorectal cancer (symptom based)	
Post treatment surveillance for colorectal cancer	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Estimate from MOH Statistical Yearbook 2019[15]
Asthma: Low dose inhaled fluticasone + SABA	
Asthma: High dose inhaled fluticasone + SABA	
Asthma: Theophylline + High dose inhaled fluticasone + SABA	
Asthma: Oral Prednisolone + Theophylline + High dose inhaled fluticasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Low-dose oral theophylline	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
COPD: exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General	
General Health (Children)	MOH Statistical Yearbook 2019[15]
Zinc supplementation	Assumption derived from UHC Service Coverage Index (WHO)[2]
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc (diarrhea treatment)	
Antibiotics for treatment of dysentery	
Treatment of severe diarrhea	
Pneumonia	
Pneumonia treatment (children, mild cases)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Treatment of severe pneumonia	
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Estimate from Alreshidi et al. (2018)[18]
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from Al-Duraibi and Am-Mutawa (2020)[19]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	

Vitamin A supplementation in pregnant women	Estimate from Azzeh and Refaat (2020)[20]
Iodine supplementation in pregnant women	
Adults	
Care for adults with low BMI	Assumption derived from Bahrain
Children	
Breastfeeding counselling and support	Assumption derived from Service Coverage Sub-Index on MNCH (WHO)[2]
Complementary feeding counselling and support	
Management of moderate acute malnutrition (children)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety disorders	
Basic psychosocial treatment for anxiety disorders (mild cases)	Assumption: 1.0%
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	Assumption: 1.0%
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Psychosocial care for peri-natal depression	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Assumption: 1.0%
Bipolar disorder	
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication	Assumption: 1.0%
Epilepsy	
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication	Assumption: 1.0%
Developmental disorders	
Basic psychosocial treatment, advice, and follow-up for developmental disorders	Assumption: 1.0%
Conduct disorders	
Basic psychosocial treatment, advice, and follow-up for behavioural disorders	Assumption: 1.0%
Dementia	
Assessment, diagnosis, advice, and follow-up for dementia	Assumption: 1.0%
Alcohol use/dependence	
Identification and assessment of new cases of alcohol use/dependence	Assumption: 1.0%
Brief interventions and follow-up for alcohol use/dependence	
Drug use/dependence	
Identification and assessment of new cases of drug use/dependence	Assumption: 1.0%
Brief interventions and follow-up for drug use/dependence	
Self-harm/suicide	
Assess and care for person with self-harm	Assumption: 1.0%
Maternal Newborn and Reproductive Health	
Family planning	

Pill - Standard daily regimen	KSA World Health Survey[16]
IUD - Copper-T 380-A IUD (10 years)	
Withdrawal	
Pregnancy care - ANC	
Tetanus toxoid (pregnant women)	Estimate from KSA World Health Survey[16]
Basic ANC	
Pregnancy care - Treatment of pregnancy complications	
Hypertensive disorder case management	Assumption: 100%
Childbirth care - Facility births	
Pre-referral management of labour complications	Assumption: 100%
Postpartum care - Other	
Treatment of postpartum haemorrhage	Assumption: 100%
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	MOH Statistical Yearbook 2019[15]
Oral Care	
Dental cleaning and preventive care	MOH Statistical Yearbook 2019[15]

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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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ABSTRACT

Objective. While the Gulf Cooperation Council (GCC) countries have demonstrated a strong commitment to strengthening primary healthcare (PHC), the costs of delivering these services in this region remain relatively unexplored. Understanding the costs of PHC delivery is essential for effective resource allocation and health system efficiency.

Design. We used an ingredient-based method to estimate the cost of delivering a selection of services at PHC facilities in the six GCC countries in 2019. Services were categorized into eight programmes: immunisation; non-communicable diseases (NCDs); oral and dental care; child health; nutrition; mental health; reproductive, maternal, neonatal, and child health; and general practice. The cost estimation focused on two key ingredients: the costs of drugs and supplies, and the healthcare workforce cost. The coverage rates of specific types of health services, including screening and mental health services, were also estimated. Data for the analysis was obtained from ministries of health, health statistics reports, online databases, national surveys, and scientific literature.

Results. The estimated costs of delivering the selected services at public PHC facilities in the six GCC countries totalled US$5.7 billion in 2019, representing 0.34% of the combined 2019 GDP. The per capita costs varied from US$69 to US$272. General practice and NCD programs constituted 79% of the total costs modelled, while mental health ranged between 0.0% and 0.3%. Over 8 million individuals did not receive NCD screening services, and over 30 million did not receive needed mental health services in public PHC facilities across the region.

Conclusions. To our knowledge, this is the first study to estimate the costs of services delivered at PHC facilities in the GCC countries. Identifying the main cost drivers and the services which individuals did not receive can be used to help strengthen PHC to improve efficiency and scale up needed services for better health outcomes.

Keywords: health economics, health services research, health systems

STRENGTHS AND LIMITATIONS OF THIS STUDY

- The selection of services and the data collection phase were conducted in collaboration with the Ministries of Health in the six Gulf Countries.
- The study estimated the cost of delivering a limited number of services, which only reflects part of the expenditure incurred at the primary healthcare level.
- Due to variations in terms of services delivered, healthcare structure, public-private balance, and population demographics, comparative assessments must be approached cautiously.

INTRODUCTION

Primary healthcare (PHC) refers to the first point of contact for individuals seeking medical care, but it also encompasses health education, prevention, and promotion(1). From an economic perspective, investing in primary care is cost-effective, as its focus on preventive measures and early interventions results in reduced disease burden, which translates into overall population health, increased productivity and lower healthcare costs(1-3). For instance, early detection and management of chronic conditions, such as non-communicable diseases (NCDs), can prevent costly hospitalisations or visits to emergency departments(1). Additionally, primary care providers can often provide care for a broader range of conditions than specialists, reducing the need for referrals and associated costs.

In 2018, 40 years after the Alma-Ata Declaration, the Astana Declaration renewed the global commitment to PHC and reaffirmed its importance as the foundation of healthcare systems(4). The Astana Declaration called for increased investment in PHC to strengthen health systems, achieve health-related Sustainable Development Goals, and attain universal health coverage.

Global demographics are changing, with ageing populations, population growth, as well as increasing health literacy, greater access to technology, and public expectations of health services leading to increased demand for healthcare, both globally and in the Eastern Mediterranean Region(5). These changes, along with an epidemiological shift from communicable towards non-communicable diseases(6-11), are influencing the transformation of PHC delivery. It is estimated that 90% of all health needs can be met at the PHC level, offering countries a clear path forward in improving health outcomes and health system efficiency(12).

The WHO Eastern Mediterranean Region has a long history of strengthening PHC, demonstrated by all countries in the region endorsing the Qatar Declaration on Primary Healthcare in 2008(12). This commitment to strengthening primary level-based health systems is growing, with a particular focus on family practice as one of the means of achieving universal health coverage (UHC). More recently, WHO EMRO has supported its Member States in the development of PHC-oriented models of care.

Understanding the cost of PHC components can help countries identify practical financing and allocation solutions to direct investment towards areas that reduce costs, such as medical supplies and health personnel training, ultimately enhancing the continuity, efficiency, and quality of health services to meet increasing demand in the Gulf region.

This study had two aims. First, to estimate and compare the costs of delivering a selection of PHC services in the six countries of the Gulf Cooperation Council (GCC) in 2019: Bahrain, Kuwait, Oman, Qatar, Saudi

Arabia (KSA) and the United Arab Emirates (UAE). Second, to estimate the coverage rates of specific types of health services, including screening and mental health services.

METHODS

Scope of the study

This study estimates the cost of delivering a selection of services at PHC facilities in the public sector arranged under eight different programmes: (1) immunisation; (2) NCDs; (3) oral and dental care; (4) child health; (5) nutrition; (6) mental health; (7) reproductive, maternal, neonatal and child health; and (8) general practice. In this study, general practice included services delivered by physicians qualified to deliver primary care to individuals, their families and their communities through general practice medical training. A comprehensive list of services was extracted from the OneHealth Tool Costing Module(13). The list was then reviewed, adjusted, and validated with focal persons from the respective health ministry to ensure it accurately reflected the public PHC system. As a result, the services included in this analysis slightly varies from country to country. The services included for each country can be found in the supplemental materials (Supplemented Material 1).

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Data sources

Demographic data were obtained from official population censuses or estimates(14-18). Disease prevalence and incidence were obtained from annual health statistics reports(19-22), national surveys, international or national databases, and local and regional literature. The number of services delivered was obtained from the focal persons from the health ministry or annual health statistics reports. When unavailable, we used proxy indicators or made assumptions based on regional and international literature. The costs of drugs and supplies and staff time requirements were extracted from the OneHealth Tool Costing Module(13), except for Qatar where standard drugs and supplies costs were completed by actual costs provided by the Primary Health Care Corporation (PHCC). However, the costs estimated in this study for Qatar remain lower than those reported by PHCC finance department due to the limited number of services included and the fact that our calculations focus solely on direct service delivery costs. Healthcare providers' annual salaries were obtained from the OneHealth Tool Costing Module(13) or the focal persons from the health ministry. When a clinical service not included in the initial list was added by the country, we estimated the drugs and supply costs and staff time requirements using data from the WHO-CHOICE database, WHO's review of vaccine price data(23), and relevant national reports or guidelines. The assumptions used in the model are presented in the supplemental materials (Supplemental Material 2 and 3).

Cost calculation model

We used an ingredient costing method to estimate the costs of a selection of services delivered at public PHC. This method consists of estimating the cost of producing a healthcare service by breaking down the total cost into the cost of individual ingredients or components, such as labour, equipment, materials, and supplies. In this analysis, the cost of one clinical service was calculated as follows: $TC=C_s x N_s$. Where *TC* is the total cost, C_s is the cost per service, and N_s is the number of services delivered in one given year. The two components used in this formula are described below.

The cost per service was obtained as follows: Cs=DSc+Lc. Where DSc is the drugs and supply costs, and Lc is the labour cost. The labour cost was calculated by multiplying the number of minutes spent by each healthcare worker involved in delivering a service by their salary per minute. We estimated the salary per minute using staff time requirements from the OneHealth Tool Costing Module, as well as annual salaries and working time assumptions (working days per year, working hours per day) validated by the focal persons in each country. Using this approach, we only monetised the fraction of time directly employed on delivering the services. Therefore, we did not consider the time spent by the healthcare providers on non-clinical activities, such as training or coordination. Moreover, we accounted for overhead costs such as training, programme management, supervision, monitoring and evaluation, communication, infrastructure and equipment, transportation, and advocacy. Since there was no available information about the overhead costs necessary for running the selected services, an estimate equivalent to 20% of the total costs was agreed upon in consultation with the focal persons from the health ministry.

To determine the number of services delivered in a year, we primarily used data from the focal persons from the health ministry or obtained from annual health statistics reports. When the number of services delivered was unavailable, we used proxy indicators or estimates based on regional and international literature. When a coverage rate expressed in percentage was available, we estimated the corresponding number of services as follows: $N_s = TP_s x PIN_s x CR_s$. Where TP_s is the target population, PIN_s is the population in need, and CR_s is the coverage rate. The target population refers to the sub-population eligible for receiving a given service, and the population in need is the percentage of the target population who should receive a service in a year. The coverage rate refers to the percentage of the population in need who effectively received a service in the year. For example, if a population of 1,000,000 are eligible for receiving a service, that 50% of them must receive it in a year, but that the coverage rate is 70%, the number of services delivered was estimated at 350,000, calculated as follows: *350,000 = 1,000,000 x 0.50 x 0.70.*

Finally, when an indicator specified the number of individuals instead of the number of services delivered, we estimated the latter using treatment assumptions from the OneHealth Tool. For example, we assumed that an individual treated for an already established ischemic heart disease generated an average of six

visits annually. The assumptions used in the model are presented in the supplemental materials (Supplemental Material 2 and 3).

Specific coverage rate estimation method

In this analysis, we also estimated the coverage rates for certain programmes (NCDs, mental health), disease types (diabetes, cardiovascular diseases, respiratory diseases), and intervention types (screening services). In this case, the coverage rates were calculated by dividing the aggregated number of individuals who received a set of selected services by the corresponding population in need. The results do not reflect the actual coverage rate at the country level since we did not consider the percentage of people who may have received similar services outside public PHC.

RESULTS

Cost of the selected primary healthcare services

The costs of the selected services delivered at the public PHC level across the six countries were estimated at US$5.7 billion in 2019. Table 1 presents the total costs for each country, as well as the cost per capita and the share of these costs in the current health expenditures (CHE) and government health expenditures (GHE). The highest cost per capita was observed in Kuwait (US$272.16), followed by Qatar (US$199.68). While KSA has the lowest per capita cost (US$68.60), the country has the highest overall cost, with an estimated US$2.3 billion in 2019. Overall, the cost of the selected services represents 0.34% of the six countries' combined 2019 GDP.

Table 1. Cost of the selected clinical services*

	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
Total costs (US$, Million)	159.7	1,203.0	298.8	558.9	2,347.4	1,180.3
Per capita cost (US$)	107.62	272.16	112.55	199.68	68.60	120.83
Total costs (% of CHE)	10.3	16.3	9.6	12.7	5.2	6.6
Total costs (% of GHE)	24.2	18.6	10.9	17.0	8.3	11.8
Total costs (% of GDP)	0.41	0.88	0.34	0.32	0.28	0.28

* The costs presented in this table include the 20% increase for overhead costs
CHE = Current Health Expenditure, GHE= Government Health Expenditures

Costs distribution

Table 2 shows the distribution of the costs disaggregated by programme. The costs related to general practice were the most prominent in five of the six countries (52.7-77.0%), while in Qatar the NCDs programme made up the largest share of total costs (57.4%). In the five other countries, the share of the NCDs programmes varied from 6.9% in Bahrain to 19.8% in the UAE. The child health programme is another significant cost driver that accounts for between 4.2% (KSA) to 20.3% (Bahrain) of the total costs. Taken altogether, these three programmes represent 80.0-93.3% of the costs modelled in the six countries. The mental health programme had the lowest costs across all six countries, with between 0.0% (Bahrain, Oman) and 0.3% (UAE) of the costs modelled in the study.

Table 2. Cost of the selected clinical services disaggregated by programme in 2019 (US$, Million)*

	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
General practice	**77.7**	**610.4**	**130.5**	**109.1**	**1,445.7**	**497.1**

% of total costs	60.8	63.4	54.6	24.4	77.0	52.7
NCDs	**8.8**	**109.3**	**36.0**	**256.5**	**189.8**	**187.2**
% of total costs	6.9	11.4	15.1	57.4	10.1	19.8
Child health	**26.0**	**162.0**	**44.8**	**51.4**	**79.1**	**177.9**
% of total costs	20.3	16.8	18.7	11.5	4.2	18.8
Immunisation	**3.7**	**10.9**	**10.1**	**14.9**	**75.0**	**20.6**
% of total costs	2.9	1.1	4.2	3.3	4.0	2.2
Oral and dental care	**4.5**	**41.3**	**6.1**	**5.0**	**25.3**	**30.2**
% of total costs	3.6	4.3	2.5	1.1	1.3	3.2
Nutrition	**4.5**	**16.0**	**6.6**	**2.2**	**25.2**	**3.5**
% of total costs	3.5	1.7	2.8	0.5	1.3	0.4
RMCH	**2.5**	**11.8**	**5.0**	**7.7**	**36.5**	**25.1**
% of total costs	1.9	1.2	2.1	1.7	1.9	2.7
Mental health	**0.1**	**0.8**	**0.0**	**0.5**	**1.2**	**2.7**
% of total costs	<0.01	0.1	0.0	0.1	0.1	0.3
Total	**127.8**	**962.5**	**239.1**	**447.3**	**1,877.9**	**1,180.3**

* The costs presented in this table do not include the 20% increase for overhead costs

Non-communicable diseases

The costs of the clinical services related to diabetes, cardiovascular diseases and chronic respiratory diseases (asthma and chronic obstructive pulmonary diseases) were estimated at US$676 million in 2019 across all six countries (Table 3). As these diseases are three of the major NCDs, we sought to understand the cost burden associated with managing and treating them. Based on the coverage rates and populations in need, we estimated that 14,911,170 individuals did not receive the services they needed at public PHC facilities in 2019.

Table 3. Cost of clinical services provided and estimated number of patients who did not receive services needed at the public PHC level for diabetes, cardiovascular and respiratory diseases

	Cost (US$, Million)*	% of total costs	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	5.03	3.9%	284,410
Kuwait	102.75	10.7%	947,920
Oman**	32.27	13.5%	376,910
Qatar***	254.44	56.9%	1,458,590
KSA	108.07	5.8%	9,950,800
UAE	173.16	18.3%	1,892,540

Total	675.72		14,911,170

* The costs presented in this table do not include the 20% increase for overhead costs
** Coverage rate was calculated considering Omani nationals only.
*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

NCD screening services

Table 4 shows the costs and coverage rates of seven NCD screening services (screening for risk of cardiovascular diseases and diabetes, clinical breast examination, pap smear, faecal occult blood test, and screening for diabetes complications). The total cost of these screening services across all six countries was estimated at US$18.1 million in 2019. In all countries, these costs account for less than 1% of the total costs modelled. Based on the coverage rates and populations in need, we estimated that 30,435,980 individuals did not receive the screening services they needed at public PHC facilities in 2019.

Table 4. Cost and coverage rate for services provided and estimated number of patients who did not receive services needed at the public PHC level for screening services

	Cost (Million, US$)*	% of total costs	Coverage rate (%)	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	0.9	0.7%	6%	1,058,870
Kuwait	1.1	0.1%	6%	3,184,360
Oman**	0.2	0.1%	7%	953,920
Qatar***	2.0	0.5%	4%	1,445,050
KSA	5.8	0.3%	5%	18,912,380
UAE	8.1	0.9%	5%	4,881,400
Total	**18.1**			**30,435,980**

* The costs presented in this table do not include the 20% increase for overhead costs
** Coverage rate was calculated considering Omani nationals only.
*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

Mental health services

The total cost of mental health services was estimated at US$5.3 million in 2019 across all six countries (Table 5). These costs made up between 0.0% (Bahrain, Oman) and 0.3% (UAE) of the total costs modelled. Based on the coverage rates and populations in need, we estimated that 8,724,160 individuals did not receive the mental services they needed at public PHC facilities in 2019.

Table 5. Cost and coverage rate for services provided and estimated number of patients who did not receive services needed at the public PHC level for mental health services

	Cost (Million, US$)*	% of total costs	Coverage rate (%)	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	0.1	0.0%	2%	206,090
Kuwait	0.8	0.1%	8%	267,310
Oman**	0.0	0.0%	0%	142,890
Qatar***	0.5	0.1%	2%	430,720
KSA	1.2	0.1%	1%	6,993,490
UAE	2.7	0.3%	4%	683,660
Total	**5.3**			8,724,160

* The costs presented in this table do not include the 20% increase for overhead costs

** Coverage rate was calculated considering Omani nationals only. Mental health services are not provided within primary care in Oman.

*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

DISCUSSION

This study aimed to estimate the cost of selected clinical services provided at public PHC facilities in the six countries of the GCC. By assessing the costs of delivering multiple programmes, including general practice, child health, immunisation, oral and dental care, nutrition, reproductive, maternal, neonatal and child health, and mental health at the public PHC level, this study underscores the importance of strengthening the public PHC and provide policymakers with crucial cost estimates to inform resource allocation and strategic planning for achieving improved health outcomes. This research, the first of this kind in the region, also highlights the significance of conducting tailored assessments that take into account the diverse healthcare landscapes of countries. Furthermore, our findings offer a foundation for future comparative analyses, fostering a deeper understanding of global variations in PHC financing. The findings indicate that the cost of selected services across eight programmes exceeded US$5.7 billion in 2019. While these costs represent 0.34% of the combined GDP in 2019, WHO recommends that countries allocate at least 1% of their GDP to PHC(24). It is crucial to note that the estimated costs in our study do not encompass the entirety of PHC expenditures, making it challenging to assess our results in relation to WHO's recommendation. We observed significant variations in per capita cost, with KSA having the lowest (US$68) and Kuwait having the highest (US$217) cost. We attribute these variations to different reasons. Firstly, each country has a unique health system, which includes varying proportions of private care delivery and different healthcare delivery organisation. Secondly, the differences in population structure may also affect the costs of these services. The diverse demographic profiles of the six countries may influence the prevalence of certain health conditions, the demand for specific services, and the overall utilisation of PHC. For instance, Saudi Arabia has a higher proportion of its population aged less than 19, while the UAE has a larger working-age population(25). These variations in population structure have implications for healthcare demand, notably regarding NCDs. Another element to consider is the differences in the proportion of non-nationals across the six countries(26). In the UAE and Qatar, the population is predominantly composed of non-nationals, whereas KSA has a majority of nationals. To address this particularity, countries have established unique health coverage mechanisms, creating variations in PHC utilisation(27). Lastly, these variations also result from differences in what interventions are delivered at the PHC level as opposed to other healthcare system levels, as well as coverage rates. While these factors demonstrate the complexity of comparing the cost of clinical services delivered at PHC facilities, this study allowed us to identify the main cost drivers and make recommendations. A study conducted in Indonesia in 2020 shares some methodological similarities with this one(28). This study aimed to estimate the costs of reaching national health targets at the primary healthcare level between 2020-2024 using the OneHealth Tool. Nevertheless, a direct comparison between the two studies remains challenging due to significant variations in interventions and programmes, and the more comprehensive costing approach used by the Indonesian study. These differences highlight the nuanced nature of primary healthcare costing,

emphasising the need for context-specific assessments tailored to the unique healthcare landscapes of individual regions or countries.

Generally, the services classified under general practice were the main drivers of the total costs in all countries, followed by services related to preventing, treating, and managing NCDs. The large share of general practice in the total costs can be explained by the many services included within this programme. Costs of services related to NCDs are likely due to the high prevalence of these diseases, particularly diabetes, cardiovascular and respiratory diseases, in the six countries. A previous study found that NCDs killed nearly 43,000 people in the Gulf countries in 2019 and generated an economic burden estimated at around US$50 billion, equivalent to 3.3% of the GDP(29). We also observed that the share of costs associated with these services is significantly higher in Qatar (57.4%) than in the five other countries, where it ranges from 6.9% to 19.8%. This factor could be attributed to Qatar being the only country where actual drugs and supplies costs were used in this analysis. Indeed, the actual unit costs provided by Qatar were significantly higher than those extracted from the OneHealth Tool, which were used for the remaining five countries. This suggests that the overall costs for these countries may have been underestimated. However, this could not be verified with the other countries. The substantial contribution of NCD-related services to the total costs modelled also reflects a shift of healthcare demands towards NCDs that countries have been experiencing over the past decades. The GCC countries have made significant strides in the prevention and control of NCDs, most of them having multisectoral coordination mechanisms, comprehensive strategies and targeted programmes(29). For example, the UAE launched 42 NCD clinics between 2017 and 2018 and trained PHC staff in the early detection and management of NCDs(30). Our findings also indicate that mental health services made up between 0.0% and 0.3% of the costs of the selected services. A few countries have taken commendable steps to respond to the increasing prevalence of mental health conditions, such as Bahrain, which established school mental health clinics, implemented a training programme for family physicians, and upgraded its guidelines for mental health(6). However, these programmes did not reach the same level of maturity as other NCD programmes, and ensuring better access to mental health services and reducing the stigma surrounding mental health conditions remain key challenges in the region.

In terms of coverage, the study estimated that approximately 15 million people did not receive necessary NCDs-associated services, and around 9 million people did not receive necessary mental health services at the public PHC level across all six countries in 2019. As the analysis only modelled the cost of services delivered at the public PHC level, individuals could have received these services in the private sector or at the secondary or tertiary level of the public sector. For example, around 67,000 mental health visits were recorded in Oman through extended healthcare centres in 2019(20), but none were included in our costing model.

We estimated that, across the six countries, around 30 million people did not receive the NCD screening services they required in public PHC. This includes screening for cardiovascular diseases, cervical, breast and colorectal cancers, diabetes and diabetes complications. Additionally, we found that the coverage rates for these seven services were consistently low across the countries, ranging from an average of 4% in Qatar to 7% in Oman. While these results show relatively low access to screening services, they should be qualified by the consideration that screening and awareness-related activities are rarely directly captured in health statistics records and health surveys, making them difficult to estimate accurately.

Limitations

This study had some limitations which must be considered when interpreting the results. Firstly, the list of services included in this study did not include all PHC services. It is also important to note that the selection of services may inadvertently introduce a bias towards NCDs because of the greater representation of these services among those available in the OneHealth Tool Costing Module. To mitigate this potential risk, we actively engaged with the six Ministries of Health during the selection process, allowing them to include additional services. Even if a risk of bias remains, we considered the greater representation of NCD-related services to reflect the current activity and priorities of the public PHC in each country. Secondly, it is important to note that services included in the general practice programme could potentially overlap with other programmes. Challenges related to clearly delineating this programme in each of the six countries introduce uncertainty regarding the distribution of the costs per programme. Thirdly, the drugs and supply costs for each clinical service were estimated using cost assumptions from the OneHealth Tool Costing Module, except for Qatar where primary data was collected. Fourthly, service coverage data was not always available, which required making assumptions based on similar interventions or available data from neighbouring countries. The coverage rates must be interpreted with caution as they only reflect the number of services delivered at the public PHC level, and some services may also be delivered at other levels of the public health system and/or in the private sector. Moreover, without detailed information on the proportion of individuals utilising private care instead of public care, it becomes challenging to fully contextualise and evaluate the coverage rates. Fifthly, the study did not have information on overhead costs such as training, programme management, supervision, monitoring and evaluation, communication, infrastructure and equipment, transportation, and advocacy, and an estimation of 20% of the total costs was agreed upon to account for this. Finally, comparisons between countries and with other published estimates of PHC spending should be made with caution due to differences in the number and nature of the clinical services included for each country, variations in the healthcare system and population structure, and different data sources used.

Recommendations

The significance of robust PHC in establishing effective and efficient health systems is well acknowledged by all six GCC countries. They have made commendable strides in strengthening PHC by adapting to the evolving disease burden of their populations, as evident from the allocation of substantial costs to NCD services in this study. The comprehensive costing analysis presented in this report sheds light on specific areas where further enhancements in PHC services and resource allocation across the GCC countries can be made. To reap substantial health and economic advantages, the following recommended actions deserve consideration:

1. **Strengthen the primary health workforce:** To address the shortage of skilled healthcare professionals in the primary care sector, the GCC countries should focus on increasing investment in training, attracting, and retaining local Family Physicians (FPs) and General Practitioners (GPs). This can be achieved through incentivising primary care training programmes, such as providing scholarships for nationals pursuing careers in primary care professions. Scaling up the primary health workforce will involve initial and ongoing training and remuneration costs, but the potential health and economic gains justify this investment.

2. **Expand NCD prevention and screening services:** Investing in disease prevention and routine screening services at the public PHC level is vital for strong PHC. The GCC countries have an opportunity to scale up their screening services for NCDs in public PHC, as over 30 million people in the region did not receive the required NCD screening services in 2019. To assess coverage fully, further research into private sector service provision and primary care coverage in the GCC countries is recommended. Scale-up of PHC services should be done with a focus on accessibility, equity, and achieving universal health coverage.

3. **Scale-up mental health services:** Despite progress in ensuring access to mental health services and reducing stigma, the majority of mental health services are still delivered at the secondary or tertiary level in the GCC region. Integrating mental health screening and care services into public PHC, especially in general practice, can improve accessibility and lead to better health outcomes compared to treatment at higher-level facilities. Scaling up mental health services at the PHC level aligns with a people-centered approach to PHC that addresses health and disease comprehensively.

4. **Enhance regional collaboration and policy coherence:** The GCC countries share common challenges and opportunities in strengthening PHC. Establishing a GCC PHC Coordination Committee with regular meetings to share best practices, lessons learned, and promote legislative

action will support regional collaboration. The committee should focus on NCD prevention, screening, and treatment at the PHC level, and consider establishing a database to track progress and emerging challenges in NCD-related targets and indicators. Regional strategies and action plans should be developed to further promote policy coherence and collaboration.

5. **Invest in research and monitoring of PHC:** To improve the efficiency and health outcomes of PHC systems in the GCC region, there should be a focus on research and monitoring. By integrating an effectiveness perspective into this research, GCC countries could identify quick wins, as well as areas and services that require more resources or could be run more efficiently. Scaling up research and monitoring into PHC will provide a stronger evidence base and enable assessment of the impact of potential changes in PHC service delivery. Additionally, defining UHC health benefits packages will facilitate modelling costs associated with the included services.

By implementing these recommendations, the GCC countries can strengthen their PHC systems, leading to improved health outcomes and more efficient resource allocation. These actions will contribute to building effective and robust health systems that effectively address the changing disease burden of the population.

CONCLUSION

To our knowledge, this study is the first that aimed to estimate the costs of services delivered at PHC in the GCC countries. The findings indicate that general practice, child health, and NCDs, particularly diabetes, cardiovascular and respiratory diseases, were the main cost drivers. This study also shows that, in all countries, a significant number of individuals didn't receive essential services, such as screening for NCDs or mental health services, at the public PHC level. Based on these results, we recommend actions to increase the availability and accessibility of prevention and screening services, integrate mental health screening and care services into primary care, and expand research and monitoring efforts on PHC investment, both in the public and private sectors.

Abbreviations

FP	Family Physician
GCC	Gulf Cooperation Council
CHE	Current Health Expenditures
GHE	Government Health Expenditures
KSA	Kingdom of Saudi Arabia
PHC	Primary Healthcare
PHCC	Primary Healthcare Coorporation
NCD	Non-Communicable Disease
UAE	United Arab Emirates
UHC	Universal Health Coverage
WHO	World Health Organization

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Competing Interests

The authors declare no conflict of interest.

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Contributors

KE and SP substantially contributed to the conception, methodology development and data collection; conducted the data analysis, economic modelling and interpretation of data; and drafted the manuscript. DG, JJ, RG, and RS substantially contributed to the conception and design, literature search, data collection, interpretation of data and drafting of the manuscript. TA, MM, LS, MA, ZA, SA, SF, HRS, and MA contributed to data collection and interpretation of data and revised the article critically for important intellectual content. LM, DA, YA, NB, and DT contributed to the conception and design, provided guidance on scope and interpretation of results, and revised the article critically for important intellectual content. KE, SP and DG are responsible for the overall content as guarantors. All authors approved the version of the manuscript to be published.

Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information.

Ethics statements

Ethics approval was not required for this economic evaluation study. We used publicly accessible documents and data to conduct the economic analysis.

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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Supplementary Materials

Table S1. List of selected services by country

Service	Bahrain	KSA	Kuwait	Oman	Qatar	UAE
Immunization						
Anti-rabies			X			
BCG vaccine	X	X	X	X	X	X
DPT vaccine	X		X	X	X	X
DT Adult			X			
DT paediatrics			X			
Heb B vaccine (paediatrics)			X			
Hep B vaccine	X				X	X
Hib vaccine	X				X	X
HPV vaccine		X				X
Influenza vaccine	X		X		X	X
Measles vaccine	X	X	X	X	X	X
Meningococcal vaccine			X			
Pentavalent vaccine		X	X	X		
Pneumococcal vaccine	X	X	X	X	X	X
Polio vaccine	X	X	X	X	X	X
Rotavirus vaccine	X		X		X	X
Rubella vaccine		X				
TT			X			
Varicella vaccine	X	X	X	X	X	
Non-Communicable Diseases						
Breast Cancer						
Basic breast cancer awareness	X	X	X	X	X	X
Diagnosis after screened with clinical breast exam			X	X		X
Diagnosis after screened with mammography						X
Diagnosis without screening for breast cancer						X
Diagnosis: screened with clinical breast exam		X				

Diagnosis: screened with mammogram		X				
Post-treatment surveillance for breast cancer patients		X				
Screening: clinical breast examination	X	X	X	X	X	X
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Screening: mammography		X				X
Cervical Cancer						
HPV DNA + VIA						X
Papanicolaou test (pap smear)	X	X	X	X	X	X
Post-treatment surveillance for cervical cancer		X				
Visual inspection with acetic acid (VIA)						X
Colorectal Cancer						
Diagnosis for colorectal cancer screened with FIT						X
Diagnosis for colorectal cancer screened with FOBT		X				X
Diagnosis without screening for colorectal cancer (symptom based)		X				X
Post-treatment surveillance for colorectal cancer		X				
Screening: colonoscopy		X				
Screening: faecal immunochemical test						X
Screening: faecal occult blood testing	X	X	X	X	X	X
Screening: sigmoidoscopy		X				
CVD & Diabetes						
Follow-up care for those at low risk of CVD/Diabetes (absolute Risk: 10-20%)	X	X	X	X	X	X
Intensive glycaemic control	X	X	X	X	X	X
Neuropathy screening and preventive foot care	X	X	X	X	X	X
Referral for retinopathy screening				X		
Retinopathy screening	X		X		X	X
Screening for risk of CVD/Diabetes	X	X	X	X	X	X
Standard glycaemic control	X	X	X	X	X	X
Treatment for those with absolute risk of CVD/Diabetes 20-30%	X	X	X	X	X	X
Treatment for those with established cerebrovascular disease and post stroke	X	X	X	X	X	X
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	X	X	X	X	X	X
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	X	X	X	X	X	X
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	X	X	X	X	X	X
Treatment of cases with established ischaemic heart disease (IHD)	X	X	X	X	X	X
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	X	X			X	X
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	X	X	X	X	X	X
Emergency care						
Average annual emergency care needs	X	X	X	X	X	X
Oral Care						

Dental cleaning and preventive care	X	X	X	X	X	
Oral and dental care						X
Respiratory Diseases						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Asthma: high dose inhaled beclomethasone + SABA	X		X		X	X
Asthma: high dose inhaled fluticasone + SABA		X		X		
Asthma: inhaled short acting beta agonist for intermittent asthma	X	X	X	X	X	X
Asthma: low dose inhaled beclomethasone + SABA	X		X		X	X
Asthma: low dose inhaled fluticasone + SABA		X		X		
Asthma: oral prednisolone + theophylline + high dose inhaled fluticasone + SABA		X		X		
Asthma: theophylline + high dose inhaled fluticasone + SABA		X		X		
COPD: exacerbation treatment with antibiotics	X	X	X	X	X	X
COPD: exacerbation treatment with oral prednisolone	X	X	X	X	X	X
COPD: exacerbation treatment with oxygen		X		X		X
COPD: inhaled salbutamol	X	X	X	X	X	X
COPD: ipratropium inhaler	X	X	X	X	X	X
COPD: low-dose oral theophylline	X	X	X	X	X	
COPD: smoking cessation	X	X	X	X	X	X
Child Health						
Deworming						
Deworming	X		X	X	X	
Diarrhea management						
Antibiotics for treatment of dysentery		X		X		X
ORS	X	X	X	X	X	X
Treatment of severe diarrhea		X				
Zinc (diarrhea treatment)		X		X		
General						
Zinc supplementation		X		X		
Child general health	X	X	X	X	X	X
School health	X				X	
Malaria						
Malaria treatment (0-4, mild cases)				X		
Pneumonia						
Pneumonia treatment (children)	X	X	X	X	X	X
Treatment of severe pneumonia		X				
Routine Child Health Care Visit						
Routine child health care visit (< 1 year)						X
Routine child health care visit (1-5 years)						X
School Health Program						

Dental screening				X		
Ear screening				X		
Eye screening				X		
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Nutrition						
Adults						
Care for adults with food allergies and sensitivities						X
Care for adults with hyperuricemia						X
Care for adults with kidney diseases						X
Care for adults with low BMI	X	X	X	X	X	
Care for adults with nutritional anaemia						X
Care for adults with other nutritional diseases						
Care for diabetic adults						X
Care for obese adults						X
All populations						
Food fortification						X
Children						
Breastfeeding counselling and support	X	X	X	X	X	
Complementary feeding counselling and support	X	X	X	X		
Feeding counselling and support for infants and young children in emergency situations						
Intermittent iron supplementation in children	X		X	X	X	
Management of food allergies or food intolerances						X
Management of moderate acute malnutrition						X
Management of moderate acute malnutrition (children)		X		X		
Management of severe malnutrition						X
Pregnant and lactating women						
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia				X		
Daily FAF, postpartum, anaemic women				X		
Daily iron and folic acid supplementation (pregnant women)	X	X	X	X	X	
Intermittent FAF, postpartum, non-anaemic pregnant women				X		
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	X	X	X	X	X	
Iodine supplementation in pregnant women		X				
Vitamin A supplementation in pregnant women		X				
Women of reproductive age and adolescent girls						
Intermittent iron-folic acid supplementation	X	X	X	X	X	
Mental Health						
Alcohol use/ dependence						
Identification and assessment of new cases of alcohol use/dependence				X		X

Brief interventions and follow-up for alcohol use/dependence		X		X		
Identification and assessment of new cases of alcohol use/dependence		X				
Anxiety Disorders						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Basic psychological treatment for anxiety disorders (mild cases).	X		X	X	X	X
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (mild-moderate cases)	X	X	X		X	X
Basic psychosocial treatment for anxiety disorders (mild cases)		X				
Attention Disorders						
Methylphenidate medication						X
Bipolar Disorders						
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication		X				X
Conduct Disorders						
Basic psychosocial treatment, advice, and follow-up for behavioural disorders		X				X
Dementia						
Assessment, diagnosis, advice, and follow-up for dementia		X				X
Dementia screening, basic work up and referral to tertiary care				X		
Pharmacological treatment of dementia						X
Depression						
Basic psychosocial treatment and anti-depressant medication of first episode (mild to moderate cases)				X		
Basic psychosocial treatment and anti-depressant medication of first episode (moderate-severe cases)	X	X	X		X	X
Basic psychosocial treatment for mild depression	X	X	X	X	X	X
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis						X
Psychosocial care for perinatal depression						X
Psychosocial care for perinatal depression for mild cases only				X		
Developmental Disorders						
Basic psychosocial treatment, advice, and follow-up for developmental disorders		X				X
Drug use/dependence						
Brief interventions and follow-up for drug use/dependence		X		X		X
Identification and assessment of new cases of drug use/dependence		X		X		
Epilepsy						
Basic psychosocial support, advice, and follow-up only				X		
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication		X				X
Psychosis						
Basic psychosocial support and anti-psychotic medication		X		X		X
Self-harm/suicide						
Assess and care for person with self-harm		X		X		

Basic psychosocial treatment, advice, and follow-up for self-harm/suicide				X		
Pesticide intoxication management				X		
Maternal Newborn and Reproductive Health						
Antenatal Care (ANC)						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Antenatal Care (ANC)						X
Childbirth care - Facility births						
Feeding counselling and support for low-birth-weight infants				X		
Kangaroo mother care				X		
Labour and delivery management				X		
Manual removal of placenta				X		
MgSO4 for eclampsia				X		
Neonatal resuscitation				X		
Parenteral administration of uterotonics				X		
Pre-referral management of labour complications		X		X		
Treatment of local infections (newborn)				X		
Family planning						
Condom - male				X		
Contraception management					X	
Implant - Implanon (3 years)				X		
Injectable - 3 month (depo provera)	X		X	X		
IUCD follow-up care	X		X		X	
IUD - Copper-T 380-A IUD (10 years)		X		X		
Lactational amenorrhea method				X		
Other contraceptives	X		X			
Periodic abstinence				X		
Pill - progestin only	X		X	X		
Pill - standard daily regimen		X				
Standard days method				X		
Withdrawal		X		X		
Post-abortion case management			X		X	
Management of ectopic pregnancy care						
Ectopic case management				X		
Menopause Program						
Screen for mood disorders				X		
Screen for urogenital dryness				X		
Other						
Postmenopausal care			X			
Management of abnormal uterine bleeding			X			

Management of amenorrhea			X			
Management of hirsutism			X			
Management of irregular cycles			X			
Management of mild endometriosis			X			
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Management of PCO			X			
Management of pre pubertal problems (delayed menarche, infection)			X			
Other sexual and reproductive health						
Cervical cancer screening		X	X			
Identification and management of infertility	X	X	X	X	X	
Treatment of chlamydia	X	X	X	X	X	
Treatment of gonorrhoea	X	X	X	X	X	
Treatment of pelvic inflammatory disease	X	X	X	X	X	
Treatment of syphilis	X	X	X	X	X	
Treatment of trichomoniasis	X	X	X	X	X	
Treatment of urinary tract infection	X	X	X	X	X	
Postpartum Care						
Breast feeding education and advice	X		X		X	
Mastitis	X		X	X		
Postnatal care						X
Postpartum care examination					X	
Treatment of postpartum haemorrhage	X	X	X	X	X	
Maternal sepsis case management				X		
Preconception Care (PCC)						
Preconception care						X
Pregnancy Care						
Basic ANC	X	X	X	X	X	
Syphilis detection and treatment (pregnant women)	X		X		X	
Tetanus toxoid (pregnant women)	X	X	X	X	X	
Syphilis screening (pregnant women)				X		
Pregnancy care - Treatment of pregnancy complications						
Deworming (pregnant women)	X		X	X		
Hypertensive disorder case management		X		X		
Management of other pregnancy complications				X		
Management of pre-eclampsia (magnesium sulphate)				X		
Premarital screening program						
Premarital screening program						X
General Practice						
General practice	X	X	X	X	X	X

Table S2. Assumptions used to estimate the population in need, drugs and supplies costs, and labour costs (all countries)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Varicella vaccine	Children 1 and 5 years old, for the first and the second dose	USD 17.5 for one dose (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Influenza vaccine	Children 0-5 + Pregnant women + People 65+	USD 2.39 for one dose (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Retinopathy screening	People with diabetes should be screened every year (100%)	-	-
Neuropathy screening	People with diabetes should be screened every year (100%)	-	-
Clinical breast examination	Women aged 40-70 should be screened every 2 years (50%)	-	-
Diagnosis after screened with clinical breast examination	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Pap smear	Women 30-49 should be screened every 3 years (33%)	-	-
Faecal occult blood screening	People 50+ should be screened every 10 years (10%)	-	-
Dental cleaning and preventive care	All population	No costs estimated	Nurse (20 min) and Dentist (15 min) for one visit
General child health	Children 0-14	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
Pneumonia treatment	-	-	Nurse (20 min) + GP (20 min) for one visit
Daily iron and folic acid supplementation (anaemic pregnant women)	100% of anaemic pregnant women (World Bank)	-	-
Intermittent iron folic acid supplementation (non-anaemic pregnant women)	100% of non-anaemic pregnant women (World Bank)	-	-
Daily FAF, postpartum, non-anaemic women	Based on number of live births (Annual Health Statistics) and percentage of anaemic women (World Bank)		

Intermittent FAF, postpartum, anaemic women	Based on number of live births (Annual Health Statistics) and percentage of non-anaemic women (World Bank)		
Care for adults with low BMI	100% of underweight adults (Global Nutrition Report)	-	-
All mental health clinical services	Based on prevalence rates (Zuberi et al. 2021, GBD 2016 Epilepsy Collaborators, GBD 2016 Dementia Collaborators, WHO-EMRO, Atlas of Substance Disorder).	-	-
Treatment of postpartum haemorrhage (PPH)	Based on incidence rates of PPH	-	-
Identification and management of infertility	Based on regional prevalence (Eldib 2018) among adults 15-49 (3.8%)	-	-
Treatment of syphilis	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (2.2%)	-	-
Treatment of gonorrhoea	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (0.9%)	-	-
Treatment of chlamydia	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (1.9%)	-	-
Treatment of trichomoniasis	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (2.8%)	-	-
Treatment of pelvic inflammatory infection	Based on US incidence rate (Kresiel 2021) among adults 15-49 (3.6%)	-	-
General practice	All population	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
All Services	-	-	Community health workers time was allocated to nurses

Table S2-A. Country-specific assumptions (Oman)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
School health program (eye screening)	Children in grade 1, 4, 7 and 10	No costs estimated	Nurse (10 min) for one visit
School health program (dental screening)	Children in grade 1	No costs estimated	Nurse (10 min) for one visit

School health program (ear screening)	Children in grade 1 and 2	No costs estimated	Nurse (10 min) for one visit
Menopause program: screen for urogenital dryness, screen for mood disorders	Women 45-55 (100%)	No costs estimated	GP (15 min) for one visit
Elderly and community care program	People 60+	No costs estimated	Nurse (45 min) for one visit

Table S2-B. Country-specific assumptions (Bahrain)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
School health	Children 5-19	No costs estimated	Nurse (10 min) for one visit

Table S2-C. Country-specific assumptions (Kuwait)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Meningococcal vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 10.6 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
DT adult vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 1.8 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
DT pediatrics vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 1.8 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Anti-rabies vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 48.6 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Hep B vaccine (paediatrics)	PIN was not estimated since the number of visits was directly provided by MOH	USD 3.24 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
TT vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 0.58 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Management of pre-pubertal problems	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Obs/Gyn (15 min) for one visit
Management of PCO, hirsutism, irregular cycles, amenorrhea, abnormal uterine bleeding, management of mild endometriosis, postmenopausal care	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Obs/Gyn (15 min) for one visit

Table S2-D. Country-specific assumptions (Qatar)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Child General Health	Children 0-14	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
School health	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Nurse (10 min) for one visit
Postpartum care examination	PIN was not estimated since the number of visits was directly provided by MOH	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (10 min) and Midwife (20 min) for one visit
Allied health	PIN was not estimated since the number of visits was directly provided by MOH	Cost per outpatient visit (WHO-CHOICE) – Labour costs	Nurse (20 min) for one visit

Table S2-E. Country-specific assumptions (UAE)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Screening: mammography	Women aged 40-70 should be screened every 2 years (50%)	-	-
Diagnosis for breast cancer	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Visual inspection with acetic acid, HPV DNA + VIA.	Based on country cervix cancer incidence rate (WHO – IARC 2020)	-	-
Screening; faecal immunochemical test	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-
Diagnosis for colorectal cancer	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-
Routine child healthcare visit (1 year)	Children 0-12 months (100%)	Estimate based on OHT drugs and supplies prices: USD 19.7	Nurse (20 min), GP (10 min)
Routine child healthcare visit (1-5 years)	Children 12-59 months (100%)	Estimate based on OHT drugs and supplies prices: USD 2.8	Nurse (20 min), GP (10 min)
Nutrition: Care for obese adults	People with obesity (Global Nutrition Report)	No costs estimated	GP (10 min)
Nutrition: Care for diabetic adults	People with diabetes (OHT)	No costs estimated	GP (10 min)

Nutrition: Care for adults with kidney diseases	Adults with chronic kidney disease (Al-Shamsi et al. 2018)	No costs estimated	GP (10 min)
Nutrition: Care for adults with nutritional anaemia	Adults with anaemia (Global Nutrition Report)	No costs estimated	GP (10 min)
Nutrition: Care for adults with food allergies and sensitivities	People with nutrition-related allergies (Althumiri et al. 2021)	No costs estimated	GP (10 min), Specialist Doctor (30 min)
Management of food allergies and food intolerance	Children 0-14 x Global Prevalence of Allergies (3.0%)	No costs estimated	GP (10 min), Specialist Doctor (30 min)
Preconception care	Married women or planning for marriage at reproductive age (15-49 years)	Estimate based on OHT drugs and supplies prices: USD 4.90	Nurse (15 min), GP (15 min)
Antenatal care	Pregnant women	Estimate based on OHT drugs and supplies prices: USD 36.42	GP (40 min), Radiographer (20 min), Midwife (40 min)
Postnatal care	Women who gave birth	No costs estimated	Nurse (15 min), GP (15 min)
Premarital screening program	Women (15-49) planning for a marriage	Estimate based on OHT drugs and supplies prices: USD 15.66	Nurse (15 min), GP (15 min)

Table S2-F. Country-specific assumptions (KSA)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Screening: mammography	Women aged 40-70 should be screened every 2 years (50%)	-	-
Post-treatment surveillance for breast cancer patients	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Post treatment surveillance for cervical cancer	Based on country cervix cancer incidence rate (WHO – IARC 2020)	-	-
Screening: Sigmoidoscopy, colonoscopy	People 50+ should be screened every 10 years (10%)	-	-
Post treatment surveillance for colorectal cancer	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-

Table S3. References and assumptions used to estimate the total number of services delivered in 2019 in Oman

Immunization	Reference / Assumption
Measles vaccine	MOH Health Statistics 2019[1]
Pentavalent vaccine	
Varicella vaccine	
DPT vaccination	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs[2]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[1]
Intensive glycaemic control	
Referral for retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: clinical breast examination (CBE)	MOH Health Statistics[1]
Diagnosis after screened with clinical breast exam	Assumption derived from WHO-IARC 2020[3]
Cervical Cancer	
Papanicolaou test (pap smear)	Assumption derived from Bahrain CR
Colorectal Cancer	
Screening: faecal occult blood testing	Assumption derived from 'CBE'
Elderly and community care program	
Elderly and community care program	MOH Health Statistics 2019[1]
Respiratory Disease	

Asthma: Inhaled short acting beta agonist for intermittent asthma	MOH Health Statistics 2019[1]
Asthma: Low dose inhaled fluticasone + SABA	
Asthma: High dose inhaled fluticasone + SABA	
Asthma: Theophylline + High dose inhaled fluticasone + SABA	
Asthma: Oral Prednisolone + Theophylline + High dose inhaled fluticasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: Exacerbation treatment with antibiotics	
COPD: Exacerbation treatment with oral prednisolone	
COPD: Exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General	
Child general health	Assumption: 25% of GP visits (MOH Health Statistics 2019[1])
Deworming	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc supplementation	
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc (diarrhea treatment)	
Antibiotics for treatment of dysentery	
Pneumonia	
Pneumonia treatment (children, mild cases)	Estimate from MOH Health Statistics 2019[1]
Malaria	
Malaria treatment (0-4, mild cases)	Estimate from MOH Health Statistics 2019[1]
School Health Program	
Eye screening	MOH Health Statistics 2019[1]
Dental screening	
Ear screening	
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 5%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from MOH Health Statistics 2019[1]

Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia	
Daily FAF, postpartum, anaemic women	Estimate from MOH Health Statistics 2019[1]
Intermittent FAF, postpartum, non-anaemic pregnant women	
Adults	
Care for adults with low BMI	Assumption: 2.5%
Children	
Breastfeeding counselling and support	MOH Health Statistics 2019[1]
Complementary feeding counselling and support	Assumption derived from UHC Service Coverage Index (WHO)[2]
Intermittent iron supplementation in children	
Management of moderate acute malnutrition (children)	MOH Health Statistics 2019[1]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (mild to moderate cases)	
Depression	
Basic psychosocial treatment for mild depression	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment and anti-depressant medication of first episode (mild to moderate cases)	
Psychosocial care for peri-natal depression for mild cases only	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Estimate from MOH Health Statistics 2019[1]
Epilepsy	
Basic psychosocial support, advice, and follow-up only	Estimate from MOH Health Statistics 2019[1]
Dementia	
Dementia screening, basic work up and referral to tertiary care	Estimate from MOH Health Statistics 2019[1]
Alcohol use/ dependence	
Identification and assessment of new cases of alcohol use/dependence	Estimate from MOH Health Statistics 2019[1]
Brief interventions and follow-up for alcohol use/dependence	
Drug use/dependence	
Identification and assessment of new cases of drug use/dependence	Estimate from MOH Health Statistics 2019[1]
Brief interventions and follow-up for drug use/dependence	
Self-harm/suicide	
Assess and care for person with self-harm	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment, advice, and follow-up for self-harm/suicide	
Pesticide intoxication management	
Maternal Newborn and Reproductive Health	

Family planning	
Pill - Progestin only	MOH Health Statistics 2019[1]
Condom - Male	
Injectable - 3 month (Depo Provera)	
IUD - Copper-T 380-A IUD (10 years)	
Implant - Implanon (3 years)	Assumption: 0.5%
LAM (Lactational Amenorrhea Method)	MOH Health Statistics 2019[1]
SDM (Standard Days Method)	
Periodic abstinence	
Withdrawal	
Management of ectopic pregnancy care	
Ectopic case management	Assumption: 100%
Pregnancy care - ANC	
Tetanus toxoid (pregnant women)	Estimate from MOH Health Statistics 2019[1]
Syphilis screening (pregnant women)	MOH Health Statistics 2019[1]
Basic ANC	
Pregnancy care - Treatment of pregnancy complications	
Hypertensive disorder case management	Assumption: 99%
Management of pre-eclampsia (Magnesium sulphate)	
Management of other pregnancy complications	
Deworming (pregnant women), part of general care and not specific for pregnant women	Assumption derived from UHC Service Coverage Sub-Index on RMNH (WHO)[2]
Childbirth care - Facility births	
Parenteral administration of uterotonics	Estimate from MOH Health Statistics 2019[1]
Labour and delivery management	
Pre-referral management of labour complications	
MgSO4 for eclampsia	
Neonatal resuscitation	
Treatment of local infections (newborn)	
Kangaroo mother care	
Feeding counselling and support for low-birth-weight infants	
Manual removal of placenta	
Postpartum care - Treatment of sepsis	
Maternal sepsis case management	Estimate from MOH Health Statistics 2019[1]
Postpartum care - Other	
Mastitis	Estimate from UHC Service Coverage Sub-Index on RMNH (WHO)[2]
Treatment of postpartum haemorrhage	Assumption: 100%

Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	MOH Health Statistics 2019[1]
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)- mild cases only	
Menopause Program	
Screen for urogenital dryness	Assumption: 7.5%
Screen for mood disorders	Assumption: 7.5%
General Practice	
General Practice	Estimate from MOH Health Statistics 2019[1]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[1]

Table S4. References and assumptions used to estimate the total number of services delivered in 2019 in Bahrain

Immunization	
Rotavirus vaccine	MOH Health Statistics 2019[4]
Measles vaccine	
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	Estimate from MOH Health Statistics 2019[4]
Influenza vaccine	MOH Health Statistics 2019[4]
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Estimate from MOH Health Statistics 2019[4]
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	

Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[4]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: clinical breast examination (CBE)	MOH Health Statistics 2019[4]
Cervical Cancer	
Papanicolaou test (pap smear)	MOH Health Statistics 2019[4]
Colorectal Cancer	
Screening: faecal occult blood testing	Estimate from 'CBE' and 'pap smear'
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Asthma: low dose inhaled beclomethasone + SABA	
Asthma: high dose inhaled beclomethasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General Health	
Child general health	Assumption: 25% of total number of GP Visit (MOH Health Statistics 2019[4])
School Health	
School Health	MOH Health Statistics 2019[4]
Deworming	
Deworming	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Diarrhea management	

ORS	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 5.0%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Estimate from MOH Health Statistics 2019[4]
Children	
Breastfeeding counselling and support	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Complementary feeding counselling and support	
Intermittent iron supplementation in children	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	Estimate from MOH Health Statistics 2019[4]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	Estimate from MOH Health Statistics 2019[4]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Pill - Progestin only	United Nations 2019[5]
Injectable - 3 month (Depo Provera)	
Other contraceptives	
IUCD follow-up care	Assumption derived from UHC Service Coverage Index (WHO)[2]
Pregnancy Care	
Tetanus toxoid (pregnant women)	Estimate from MOH Health Statistics 2019[4]
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Pregnancy care - Treatment of pregnancy complications	
Deworming (pregnant women)	Assumption: 100%
Postpartum care - Other	

Mastitis	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Breast feeding education and advices	
Treatment of postpartum haemorrhage	Assumption: 100%
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	MOH Health Statistics 2019[4]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[4]

Table S5. References and assumptions used to estimate the total number of services delivered in 2019 in Kuwait

Immunization	
Rotavirus vaccine	MOH Health Statistics 2019[6]
Measles vaccine	
Pentavalent vaccine	
DPT vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	
DT Adult	
Measles vaccine	Provided by MOH
Varicella vaccine	
Influenza vaccine	
Meningococcal vaccine	
DT paediatrics	
Anti-Rabies	
Heb B vaccine (paediatrics)	
TT	

Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: CR = 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	Provided by MOH
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[6]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: CR = 5.0%
Screening: clinical breast examination	Assumption derived from Oman
Diagnosis after screened with clinical breast exam	Estimate from WHO-IARC 2020[3]
Cervical Cancer	
Papanicolaou test (pap smear)	Provided by MOH
Colorectal Cancer	
Screening: faecal occult blood testing	Provided by MOH
Respiratory Disease	
Asthma: inhaled short acting beta agonist for intermittent asthma	Estimation from data provided by MOH
Asthma: low dose inhaled beclomethasone + SABA	
Asthma: high dose inhaled beclomethasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	

General Health	
Child general health	MOH Health Statistics 2019[6]
Deworming	
Deworming	Provided by MOH
Diarrhea management	
ORS	Estimate based on data provided by MOH
Pneumonia	
Pneumonia treatment (children)	Provided by MOH
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Estimate from data provided by MOH
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Assumption derived from UHC Service Coverage Sub-Index on MRCH (WHO)[2]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Assumption derived from Bahrain
Children	
Breastfeeding counselling and support	Assumption derived from UHC Service Coverage Sub-Index on MRCH (WHO)[2]
Complementary feeding counselling and support	
Intermittent iron supplementation in children	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	OneHealth Tool[7]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	OneHealth Tool[7]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Pill - Progestin only	United Nations 2019[5]
Injectable - 3 month (depo provera)	
Other contraceptives	
IUCD follow-up care	Assumption derived from UHC Service Coverage Index (WHO)[2]
Management of abortion complications	
Post-abortion case management	Assumption (70.0%)
Pregnancy Care	

Tetanus toxoid (pregnant women)	Estimate based on data provided by MOH.
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Pregnancy care - Treatment of pregnancy complications	
Deworming (pregnant women)	Assumption (100.0%)
Postpartum care - Other	
Mastitis	Assumption derived from UHC Service Coverage Index (WHO)[2]
Breast feeding education and advices	
Treatment of postpartum haemorrhage	Estimate based on data provided by MOH.
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Provided by MOH
Cervical cancer screening	
Identification and management of infertility	
Treatment of syphilis	Estimate based on data provided by MOH
Treatment of gonorrhea	Provided by MOH
Treatment of chlamydia	Estimate based on data provided by MOH
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	Provided by MOH
Other	
Management of pre pubertal problems	Provided by MOH
Management of PCO	
Management of hirsutism	Estimate based on data provided by MOH
Management of irregular cycles	Provided by MOH
Management of amenorrhea	
Management of abnormal uterine bleeding	
Management of mild endometriosis	
Postmenopausal care	
General Practice	
General Practice	MOH Health Statistics 2019[6]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[6]

Table S6. References and assumptions used to estimate the total number of services delivered in 2019 in Qatar

Immunization	
Rotavirus vaccine	Global Health Observatory (WHO)[2]
Measles vaccine	Qatar Health Statistics 2019[8]
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	Estimate from Qatar Health Statistics 2019[8]
Influenza vaccine	Assumption derived from GCC countries
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Estimate from PHCC Official Statistics
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	
Intensive glycaemic control	
Retinopathy screening	Assumption: 1%
Neuropathy screening and preventive foot care	Assumption: 1%
Breast Cancer	
Basic breast cancer awareness	Assumption: 5%
Screening: Clinical Breast Examination	Assumption derived from GCC countries and PHCC Official Statistics
Cervical Cancer	
Papanicolaou test (Pap smear)	Assumption derived from GCC countries and PHCC Official Statistics
Colorectal Cancer	
Screening: Fecal occult blood testing	Assumption derived from GCC countries and PHCC Official Statistics
Allied Health	
Allied Health	PHCC Official Statistics

Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	PHCC Official Statistics
Asthma: Low dose inhaled beclomethasone + SABA	
Asthma: High dose inhaled beclomethasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Low-dose oral theophylline	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General Health	
Child General Health	Estimate from PHCC Official Statistics
General Health	
School Health	PHCC Official Statistics
Deworming	
Deworming	PHCC Official Statistics
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index for Infectious Diseases[2]
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Index for Infectious Diseases[2]
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 50%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from data provided by PHCC Official Statistics and World Bank[9]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Assumption: 2.5%
Children	
Breastfeeding counselling and support	Assumption: 70%
Intermittent iron supplementation in children	Assumption derived from Zainel et al. (2018)[10]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	PHCC Official Statistics
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	

Basic psychosocial treatment for mild depression	PHCC Official Statistics
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Contraception Management	Estimate from PHCC Official Statistics
Management of abortion complications	
Post-abortion case management	Estimate from PHCC Official Statistics
Pregnancy Care	
Tetanus toxoid (pregnant women)	Estimate from PHCC Official Statistics
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Postpartum care - Other	
Postpartum Care Examination	PHCC Official Statistics
Treatment of postpartum haemorrhage	
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	PHCC Official Statistics
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	PHCC Official Statistics
Oral Care and Cancer	
Dental cleaning and preventive care	PHCC Official Statistics

Table S7. References and assumptions used to estimate the total number of services delivered in 2019 in UAE

Immunization	
Rotavirus vaccine	WHO-UNICEF Estimates 2019[11]
Measles vaccine	
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	

HPV vaccine	HPV Information Centre[12]
Influenza vaccine	Assumption derived from Bahrain
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	Estimate from OneHealth Tool[7] and Dubai Government Annual Health Statistics Book 2019[13]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: Clinical Breast Examination	Estimate from Bahrain
Screening: Mammography	Assumption: 0.9%
Diagnosis after Screened with Clinical Breast Exam	Estimation from WHO IARC 2020[3]
Diagnosis after Screened with Mammography	
Diagnosis without screening for breast cancer	
Cervical Cancer	
Visual inspection with acetic acid (VIA)	Assumption: 5.0%
Papanicolaou test (Pap smear)	Assumption: 9.3%
HPV DNA + VIA	Assumption: 5.0%
Colorectal Cancer	
Screening: faecal immunochemical test	Assumption : 0.5%
Screening: faecal occult blood testing	
Diagnosis for colorectal cancer screened with FIT	Assumption: 100%
Diagnosis for colorectal cancer screened with FOBT	
Diagnosis without screening for colorectal cancer (symptom based)	
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[3]
Asthma: Low dose inhaled beclomethasone + SABA	

Asthma: High dose inhaled beclomethasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
COPD: exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Oral Care	
Oral and dental care	Estimate from Dubai Government Annual Health Statistics Book[13]
Child Health	
General Health (Children)	
General Health (Children)	Assumption: 25% of GP visits
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Antibiotics for treatment of dysentery	
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Routine Child Health Care Visit	
Routine Child Health Care Visit (< 1 year)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Routine Child Health Care Visit (1-5 years)	
Nutrition	
Adults	
Care for Obese adults	Assumption: 5.0%
Care for Diabetic adults	
Care for adults with hyperuricemia	
Care for adults with kidney diseases	
Care for adults with nutritional anaemia	
Care for adults with food allergies and sensitivities	
All populations	
Food fortification	Assumption: 100%
Children	
Management of severe malnutrition	Assumption derived from UHC Service Coverage Index (WHO)[2]
Management of moderate acute malnutrition	
Management of Food allergies or Food intolerances	Assumption: 5.0%
Mental Health	
Anxiety Disorders	
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	Estimate from Abu Dhabi Government Annual Health Statistics[14]

Basic psychological treatment for anxiety disorders (mild cases).	
Depression	
Basic psychosocial treatment for mild depression	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis	
Psychological care for peri-natal	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Bipolar Disorders	
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Epilepsy	
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Developmental Disorders	
Basic psychosocial treatment, advice, and follow-up for developmental disorders	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Conduct Disorders	
Basic psychosocial treatment, advice, and follow-up for behavioural disorders	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Attention Disorders	
Methylphenidate medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Dementia	
Assessment, diagnosis, advice, and follow-up for dementia	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Pharmacological treatment of dementia	
Alcohol Use/Dependence	
Identification and assessment of new cases of alcohol use/dependence	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Drug Use/Dependence	
Brief interventions and follow-up for drug use/dependence	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Maternal Newborn and Reproductive Health	
Preconception Care (PCC)	
Preconception Care (PCC)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Antenatal Care (ANC)	
Antenatal Care (ANC)	Assumption: 99% ANC Coverage
Postnatal Care (PNC)	
Postnatal Care (PNC)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Premarital screening program	
Premarital screening program	Assumption: 100%
General Practice	
General Practice	Estimate from Dubai Government Annual Health Statistics Book[13]

Table S8. References and assumptions used to estimate the total number of services delivered in 2019 in KSA

Immunization	
Measles vaccine	MOH Statistical Yearbook 2019[15]
Pentavalent vaccine	
Varicella vaccine	Estimate from MOH Statistical Yearbook 2019[15]
Polio vaccine	MOH Statistical Yearbook 2019[15]
BCG vaccine	
Rubella vaccine	
Pneumococcal vaccine	
HPV vaccine	Assumption: 5.0%
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Estimate from MOH Statistical Yearbook 2019[15]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	KSA World Health Survey[16]
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Standard glycaemic control	Estimate from MOH Statistical Yearbook 2019[15]
Intensive glycaemic control	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: Clinical Breast Examination	Assumption derived from Bahrain
Screening: Mammography	KSA World Health Survey[16]
Diagnosis: Screened with clinical breast exam	Estimate from WHO IARC 2020[3]
Diagnosis: Screened with mammogram	
Post-treatment surveillance for breast cancer patients	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Cervical Cancer	
Papanicolaou test (Pap smear)	KSA World Health Survey[16]
Post treatment surveillance for cervical cancer	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Colorectal Cancer	

Screening: faecal occult blood testing	Estimate from Aljumah and Aljebreen (2017)[17]
Screening: Sigmoidoscopy	
Screening: Colonoscopy	
Diagnosis for colorectal cancer screened with FOBT	Estimation from WHO IARC 2020[3]
Diagnosis without screening for colorectal cancer (symptom based)	
Post treatment surveillance for colorectal cancer	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Estimate from MOH Statistical Yearbook 2019[15]
Asthma: Low dose inhaled fluticasone + SABA	
Asthma: High dose inhaled fluticasone + SABA	
Asthma: Theophylline + High dose inhaled fluticasone + SABA	
Asthma: Oral Prednisolone + Theophylline + High dose inhaled fluticasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Low-dose oral theophylline	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
COPD: exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General	
General Health (Children)	MOH Statistical Yearbook 2019[15]
Zinc supplementation	Assumption derived from UHC Service Coverage Index (WHO)[2]
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc (diarrhea treatment)	
Antibiotics for treatment of dysentery	
Treatment of severe diarrhea	
Pneumonia	
Pneumonia treatment (children, mild cases)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Treatment of severe pneumonia	
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Estimate from Alreshidi et al. (2018)[18]
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from Al-Duraibi and Am-Mutawa (2020)[19]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	

Vitamin A supplementation in pregnant women	Estimate from Azzeh and Refaat (2020)[20]
Iodine supplementation in pregnant women	
Adults	
Care for adults with low BMI	Assumption derived from Bahrain
Children	
Breastfeeding counselling and support	Assumption derived from Service Coverage Sub-Index on MNCH (WHO)[2]
Complementary feeding counselling and support	
Management of moderate acute malnutrition (children)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety disorders	
Basic psychosocial treatment for anxiety disorders (mild cases)	Assumption: 1.0%
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	Assumption: 1.0%
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Psychosocial care for peri-natal depression	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Assumption: 1.0%
Bipolar disorder	
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication	Assumption: 1.0%
Epilepsy	
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication	Assumption: 1.0%
Developmental disorders	
Basic psychosocial treatment, advice, and follow-up for developmental disorders	Assumption: 1.0%
Conduct disorders	
Basic psychosocial treatment, advice, and follow-up for behavioural disorders	Assumption: 1.0%
Dementia	
Assessment, diagnosis, advice, and follow-up for dementia	Assumption: 1.0%
Alcohol use/dependence	
Identification and assessment of new cases of alcohol use/dependence	Assumption: 1.0%
Brief interventions and follow-up for alcohol use/dependence	
Drug use/dependence	
Identification and assessment of new cases of drug use/dependence	Assumption: 1.0%
Brief interventions and follow-up for drug use/dependence	
Self-harm/suicide	
Assess and care for person with self-harm	Assumption: 1.0%
Maternal Newborn and Reproductive Health	
Family planning	

Pill - Standard daily regimen	KSA World Health Survey[16]
IUD - Copper-T 380-A IUD (10 years)	
Withdrawal	
Pregnancy care - ANC	
Tetanus toxoid (pregnant women)	Estimate from KSA World Health Survey[16]
Basic ANC	
Pregnancy care - Treatment of pregnancy complications	
Hypertensive disorder case management	Assumption: 100%
Childbirth care - Facility births	
Pre-referral management of labour complications	Assumption: 100%
Postpartum care - Other	
Treatment of postpartum haemorrhage	Assumption: 100%
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	MOH Statistical Yearbook 2019[15]
Oral Care	
Dental cleaning and preventive care	MOH Statistical Yearbook 2019[15]

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CHEERS checklist—Items to include when reporting economic evaluations of health interventions

Section/item	Item No	Recommendation	Reported on page No/line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	P.1 / L.1-2
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	P.2 / L.1-28
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study.	P.3 / L.1-28
		Present the study question and its relevance for health policy or practice decisions.	P.4-5 / L.30-2
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	NR
Settings and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	NR
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	P.6 / L.3-14
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	P.6 / L.6-8 & Table S1
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	P.4 / L.36
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	NR
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	NR
Measurement of effectiveness	11a	Single study-based estimates: Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	NR
	11b	Synthesis-based estimates: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	NR
Measurement and valuation of 12 preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	NR
Estimating resources and costs	13a	Single study-based economic evaluation: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	P.6-7 / L.34-31

	13b	Model-based economic evaluation: Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	NR
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	NR
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	NR
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	Table S2-S8
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	NR
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	Table S1-S8
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	NR
Characterising uncertainty	20a	Single study-based economic evaluation: Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	NR
	20b	Model-based economic evaluation: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	NR
Characterising heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	NR
Discussion			
Study findings, limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	P.13-17 / L.1-3

Other			
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	P.20 / L.14-16
Conflict of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	P.20 / L.10-12

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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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ABSTRACT

Objective. While the Gulf Cooperation Council (GCC) countries have demonstrated a strong commitment to strengthening primary healthcare (PHC), the costs of delivering these services in this region remain relatively unexplored. Understanding the costs of PHC delivery is essential for effective resource allocation and health system efficiency.

Design. We used an ingredient-based method to estimate the cost of delivering a selection of services at PHC facilities in the six GCC countries in 2019. Services were categorized into eight programmes: immunisation; non-communicable diseases (NCDs); oral and dental care; child health; nutrition; mental health; reproductive, maternal, neonatal, and child health; and general practice. The cost estimation focused on two key ingredients: the costs of drugs and supplies, and the healthcare workforce cost. The coverage rates of specific types of health services, including screening and mental health services, were also estimated. Data for the analysis was obtained from ministries of health, health statistics reports, online databases, national surveys, and scientific literature.

Results. The estimated costs of delivering the selected services at public PHC facilities in the six GCC countries totalled US$5.7 billion in 2019, representing 0.34% of the combined 2019 GDP. The per capita costs varied from US$69 to US$272. General practice and NCD programs constituted 79% of the total costs modelled, while mental health ranged between 0.0% and 0.3%. Over 8 million individuals did not receive NCD screening services, and over 30 million did not receive needed mental health services in public PHC facilities across the region.

Conclusions. To our knowledge, this is the first study to estimate the costs of services delivered at PHC facilities in the GCC countries. Identifying the main cost drivers and the services which individuals did not receive can be used to help strengthen PHC to improve efficiency and scale up needed services for better health outcomes.

Keywords: health economics, health services research, health systems

STRENGTHS AND LIMITATIONS OF THIS STUDY

- The selection of services and the data collection phase were conducted in collaboration with the Ministries of Health in the six Gulf Countries.
- The study estimated the cost of delivering a limited number of services, which only reflects part of the expenditure incurred at the primary healthcare level.
- Due to variations in terms of services delivered, healthcare structure, public-private balance, and population demographics, comparative assessments must be approached cautiously.

INTRODUCTION

Primary healthcare (PHC) refers to the first point of contact for individuals seeking medical care, but it also encompasses health education, prevention, and promotion(1). From an economic perspective, investing in primary care is cost-effective, as its focus on preventive measures and early interventions results in reduced disease burden, which translates into overall population health, increased productivity and lower healthcare costs(1-3). For instance, early detection and management of chronic conditions, such as non-communicable diseases (NCDs), can prevent costly hospitalisations or visits to emergency departments(1). Additionally, primary care providers can often provide care for a broader range of conditions than specialists, reducing the need for referrals and associated costs.

In 2018, 40 years after the Alma-Ata Declaration, the Astana Declaration renewed the global commitment to PHC and reaffirmed its importance as the foundation of healthcare systems(4). The Astana Declaration called for increased investment in PHC to strengthen health systems, achieve health-related Sustainable Development Goals, and attain universal health coverage.

Global demographics are changing, with ageing populations, population growth, as well as increasing health literacy, greater access to technology, and public expectations of health services leading to increased demand for healthcare, both globally and in the Eastern Mediterranean Region(5). These changes, along with an epidemiological shift from communicable towards non-communicable diseases(6-11), are influencing the transformation of PHC delivery. It is estimated that 90% of all health needs can be met at the PHC level, offering countries a clear path forward in improving health outcomes and health system efficiency(12).

The WHO Eastern Mediterranean Region has a long history of strengthening PHC, demonstrated by all countries in the region endorsing the Qatar Declaration on Primary Healthcare in 2008(12). This commitment to strengthening primary level-based health systems is growing, with a particular focus on family practice as one of the means of achieving universal health coverage (UHC). More recently, WHO EMRO has supported its Member States in the development of PHC-oriented models of care.

Understanding the cost of PHC components can help countries identify practical financing and allocation solutions to direct investment towards areas that reduce costs, such as medical supplies and health personnel training, ultimately enhancing the continuity, efficiency, and quality of health services to meet increasing demand in the Gulf region.

This study had two aims. First, to estimate and compare the costs of delivering a selection of PHC services in the six countries of the Gulf Cooperation Council (GCC) in 2019: Bahrain, Kuwait, Oman, Qatar, Saudi

Arabia (KSA) and the United Arab Emirates (UAE). Second, to estimate the coverage rates of specific types of health services, including screening and mental health services.

METHODS

Scope of the study

This study estimates the cost of delivering a selection of services at PHC facilities in the public sector arranged under eight different programmes: (1) immunisation; (2) NCDs; (3) oral and dental care; (4) child health; (5) nutrition; (6) mental health; (7) reproductive, maternal, neonatal and child health; and (8) general practice. The categorisation of services within each program was initially based on the classification used in the OneHealth Tool Costing Module(13). However, to ensure relevance to the local context and healthcare priorities of each GCC country, this classification was further refined through collaboration with focal points from the Ministries of Health. General practice was included as an additional program to better reflect the volume and nature of services delivered at the public primary healthcare level. In this study, general practice refers to general consultations conducted by General Practitioners (GPs), which include a wide range of preventive and curative medical services, such as acute pain management, infectious diseases treatment, or health promotion and prevention. The scope of the general practice program was defined based on data retrieved from the annual health statistics reports of each selected country. As a result of this collaborative and iterative approach, the services included in this analysis slightly vary from country to country. The services included for each country can be found in the supplemental materials (Supplemented Material 1).

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Data sources

Demographic data were obtained from official population censuses or estimates(14-18). Disease prevalence and incidence were obtained from annual health statistics reports(19-22), national surveys, international or national databases, and local and regional literature. The number of services delivered was obtained from the focal persons from the health ministry or annual health statistics reports. When unavailable, we used proxy indicators or made assumptions based on regional and international literature. The costs of drugs and supplies and staff time requirements were extracted from the OneHealth Tool Costing Module(13), except for Qatar where standard drugs and supplies costs were completed by actual costs provided by the Primary Health Care Corporation (PHCC). However, the costs estimated in this study for Qatar remain lower than those reported by PHCC finance department due to the limited number of services included and the fact that our calculations focus solely on direct service delivery costs. Healthcare providers' annual salaries were obtained from the OneHealth Tool Costing Module(13) or the focal persons from the health ministry. When a clinical service not included in the initial list was added by the country,

we estimated the drugs and supply costs and staff time requirements using data from the WHO-CHOICE database, WHO's review of vaccine price data(23), and relevant national reports or guidelines. The assumptions used in the model are presented in the supplemental materials (Supplemental Material 2 and 3).

Cost calculation model

We used an ingredient costing method to estimate the costs of a selection of services delivered at public PHC. This method consists of estimating the cost of producing a healthcare service by breaking down the total cost into the cost of individual ingredients or components, such as labour, equipment, materials, and supplies. In this analysis, the cost of one clinical service was calculated as follows: $TC=C_s x N_s$. Where *TC* is the total cost, C_s is the cost per service, and N_s is the number of services delivered in one given year. The two components used in this formula are described below.

The cost per service was obtained as follows: Cs=DSc+Lc. Where DSc is the drugs and supply costs, and Lc is the labour cost. The labour cost was calculated by multiplying the number of minutes spent by each healthcare worker involved in delivering a service by their salary per minute. We estimated the salary per minute using staff time requirements from the OneHealth Tool Costing Module, as well as annual salaries and working time assumptions (working days per year, working hours per day) validated by the focal persons in each country. Using this approach, we only monetised the fraction of time directly employed on delivering the services. Therefore, we did not consider the time spent by the healthcare providers on non-clinical activities, such as training or coordination. Moreover, we accounted for overhead costs such as training, programme management, supervision, monitoring and evaluation, communication, infrastructure and equipment, transportation, and advocacy. Since there was no available information about the overhead costs necessary for running the selected services, an estimate equivalent to 20% of the total costs was agreed upon in consultation with the focal persons from the health ministry.

To determine the number of services delivered in a year, we primarily used data from the focal persons from the health ministry or obtained from annual health statistics reports. When the number of services delivered was unavailable, we used proxy indicators or estimates based on regional and international literature. When a coverage rate expressed in percentage was available, we estimated the corresponding number of services as follows: $N_s = TP_s x\ PIN_s x\ CR_s$. Where TP_s is the target population, PIN_s is the population in need, and CR_s is the coverage rate. The target population refers to the sub-population eligible for receiving a given service, and the population in need is the percentage of the target population who should receive a service in a year. The coverage rate refers to the percentage of the population in need who effectively received a service in the year. For example, if a population of 1,000,000 are eligible for receiving

a service, that 50% of them must receive it in a year, but that the coverage rate is 70%, the number of services delivered was estimated at 350,000, calculated as follows: *350,000 = 1,000,000 x 0.50 x 0.70.*

Finally, when an indicator specified the number of individuals instead of the number of services delivered, we estimated the latter using treatment assumptions from the OneHealth Tool. For example, we assumed that an individual treated for an already established ischemic heart disease generated an average of six visits annually. The assumptions used in the model are presented in the supplemental materials (Supplemental Material 2 and 3).

Specific coverage rate estimation method

In this analysis, we also estimated the coverage rates for certain programmes (NCDs, mental health), disease types (diabetes, cardiovascular diseases, respiratory diseases), and intervention types (screening services). In this case, the coverage rates were calculated by dividing the aggregated number of individuals who received a set of selected services by the corresponding population in need. The results do not reflect the actual coverage rate at the country level since we did not consider the percentage of people who may have received similar services outside public PHC.

RESULTS

Cost of the selected primary healthcare services

The costs of the selected services delivered at the public PHC level across the six countries were estimated at US$5.7 billion in 2019. Table 1 presents the total costs for each country, as well as the cost per capita and the share of these costs in the current health expenditures (CHE) and government health expenditures (GHE). The highest cost per capita was observed in Kuwait (US$272.16), followed by Qatar (US$199.68). While KSA has the lowest per capita cost (US$68.60), the country has the highest overall cost, with an estimated US$2.3 billion in 2019. Overall, the cost of the selected services represents 0.34% of the six countries' combined 2019 GDP.

Table 1. Cost of the selected clinical services*

	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
Total costs (US$, Million)	159.7	1,203.0	298.8	558.9	2,347.4	1,180.3
Per capita cost (US$)	107.62	272.16	112.55	199.68	68.60	120.83
Total costs (% of CHE)	10.3	16.3	9.6	12.7	5.2	6.6
Total costs (% of GHE)	24.2	18.6	10.9	17.0	8.3	11.8
Total costs (% of GDP)	0.41	0.88	0.34	0.32	0.28	0.28

* The costs presented in this table include the 20% increase for overhead costs
CHE = Current Health Expenditure, GHE= Government Health Expenditures

Costs distribution

Table 2 shows the distribution of the costs disaggregated by programme. The costs related to general practice were the most prominent in five of the six countries (52.7-77.0%), while in Qatar the NCDs programme made up the largest share of total costs (57.4%). In the five other countries, the share of the NCDs programmes varied from 6.9% in Bahrain to 19.8% in the UAE. The child health programme is another significant cost driver that accounts for between 4.2% (KSA) to 20.3% (Bahrain) of the total costs. Taken altogether, these three programmes represent 80.0-93.3% of the costs modelled in the six countries. The mental health programme had the lowest costs across all six countries, with between 0.0% (Bahrain, Oman) and 0.3% (UAE) of the costs modelled in the study.

Table 2. Cost of the selected clinical services disaggregated by programme in 2019 (US$, Million)*

	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
General practice	**77.7**	**610.4**	**130.5**	**109.1**	**1,445.7**	**497.1**

% of total costs	60.8	63.4	54.6	24.4	77.0	52.7
NCDs	**8.8**	**109.3**	**36.0**	**256.5**	**189.8**	**187.2**
% of total costs	6.9	11.4	15.1	57.4	10.1	19.8
Child health	**26.0**	**162.0**	**44.8**	**51.4**	**79.1**	**177.9**
% of total costs	20.3	16.8	18.7	11.5	4.2	18.8
Immunisation	**3.7**	**10.9**	**10.1**	**14.9**	**75.0**	**20.6**
% of total costs	2.9	1.1	4.2	3.3	4.0	2.2
Oral and dental care	**4.5**	**41.3**	**6.1**	**5.0**	**25.3**	**30.2**
% of total costs	3.6	4.3	2.5	1.1	1.3	3.2
Nutrition	**4.5**	**16.0**	**6.6**	**2.2**	**25.2**	**3.5**
% of total costs	3.5	1.7	2.8	0.5	1.3	0.4
RMCH	**2.5**	**11.8**	**5.0**	**7.7**	**36.5**	**25.1**
% of total costs	1.9	1.2	2.1	1.7	1.9	2.7
Mental health	**0.1**	**0.8**	**0.0**	**0.5**	**1.2**	**2.7**
% of total costs	<0.01	0.1	0.0	0.1	0.1	0.3
Total	**127.8**	**962.5**	**239.1**	**447.3**	**1,877.9**	**1,180.3**

* The costs presented in this table do not include the 20% increase for overhead costs

Non-communicable diseases

The costs of the clinical services related to diabetes, cardiovascular diseases and chronic respiratory diseases (asthma and chronic obstructive pulmonary diseases) were estimated at US$676 million in 2019 across all six countries (Table 3). As these diseases are three of the major NCDs, we sought to understand the cost burden associated with managing and treating them. Based on the coverage rates and populations in need, we estimated that 14,911,170 individuals did not receive the services they needed at public PHC facilities in 2019.

Table 3. Cost of clinical services provided and estimated number of patients who did not receive services needed at the public PHC level for diabetes, cardiovascular and respiratory diseases

	Cost (US$, Million)*	% of total costs	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	5.03	3.9%	284,410
Kuwait	102.75	10.7%	947,920
Oman**	32.27	13.5%	376,910
Qatar***	254.44	56.9%	1,458,590
KSA	108.07	5.8%	9,950,800
UAE	173.16	18.3%	1,892,540

Total	675.72		14,911,170

* The costs presented in this table do not include the 20% increase for overhead costs
** Coverage rate was calculated considering Omani nationals only.
*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

NCD screening services

Table 4 shows the costs and coverage rates of seven NCD screening services (screening for risk of cardiovascular diseases and diabetes, clinical breast examination, pap smear, faecal occult blood test, and screening for diabetes complications). The total cost of these screening services across all six countries was estimated at US$18.1 million in 2019. In all countries, these costs account for less than 1% of the total costs modelled. Based on the coverage rates and populations in need, we estimated that 30,435,980 individuals did not receive the screening services they needed at public PHC facilities in 2019.

Table 4. Cost and coverage rate for services provided and estimated number of patients who did not receive services needed at the public PHC level for screening services

	Cost (Million, US$)*	% of total costs	Coverage rate (%)	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	0.9	0.7%	6%	1,058,870
Kuwait	1.1	0.1%	6%	3,184,360
Oman**	0.2	0.1%	7%	953,920
Qatar***	2.0	0.5%	4%	1,445,050
KSA	5.8	0.3%	5%	18,912,380
UAE	8.1	0.9%	5%	4,881,400
Total	**18.1**			**30,435,980**

* The costs presented in this table do not include the 20% increase for overhead costs
** Coverage rate was calculated considering Omani nationals only.
*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

Mental health services

The total cost of mental health services was estimated at US$5.3 million in 2019 across all six countries (Table 5). These costs made up between 0.0% (Bahrain, Oman) and 0.3% (UAE) of the total costs modelled. Based on the coverage rates and populations in need, we estimated that 8,724,160 individuals did not receive the mental services they needed at public PHC facilities in 2019.

Table 5. Cost and coverage rate for services provided and estimated number of patients who did not receive services needed at the public PHC level for mental health services

	Cost (Million, US$)*	% of total costs	Coverage rate (%)	Estimated number of patients who did not receive the services needed at the public PHC level
Bahrain	0.1	0.0%	2%	206,090
Kuwait	0.8	0.1%	8%	267,310
Oman**	0.0	0.0%	0%	142,890
Qatar***	0.5	0.1%	2%	430,720
KSA	1.2	0.1%	1%	6,993,490
UAE	2.7	0.3%	4%	683,660
Total	**5.3**			8,724,160

* The costs presented in this table do not include the 20% increase for overhead costs

** Coverage rate was calculated considering Omani nationals only. Mental health services are not provided within primary care in Oman.

*** In Qatar, costing data was directly provided by the Primary Healthcare Corporation (PHCC). Services delivered by other providers, such as the Red Crescent, were not included in the study.

DISCUSSION

This study aimed to estimate the cost of selected clinical services provided at public PHC facilities in the six countries of the GCC. By assessing the costs of delivering multiple programmes, including general practice, child health, immunisation, oral and dental care, nutrition, reproductive, maternal, neonatal and child health, and mental health at the public PHC level, this study underscores the importance of strengthening the public PHC and provide policymakers with crucial cost estimates to inform resource allocation and strategic planning for achieving improved health outcomes. This research, the first of this kind in the region, also highlights the significance of conducting tailored assessments that take into account the diverse healthcare landscapes of countries. Furthermore, our findings offer a foundation for future comparative analyses, fostering a deeper understanding of global variations in PHC financing. The findings indicate that the cost of selected services across eight programmes exceeded US$5.7 billion in 2019. While these costs represent 0.34% of the combined GDP in 2019, WHO recommends that countries allocate at least 1% of their GDP to PHC(24). It is crucial to note that the estimated costs in our study do not encompass the entirety of PHC expenditures, making it challenging to assess our results in relation to WHO's recommendation. We observed significant variations in per capita cost, with KSA having the lowest (US$68) and Kuwait having the highest (US$217) cost. We attribute these variations to different reasons. Firstly, each country has a unique health system, which includes varying proportions of private care delivery and different healthcare delivery organisation(25-30). According to the latest data from the World Bank, the percentage of domestic general government health expenditure relative to total current health expenditure varied markedly across the six countries in 2019, ranging from 61% in the United Arab Emirates to 90% in Oman(31). Secondly, the differences in population structure may also affect the costs of these services. The diverse demographic profiles of the six countries may influence the prevalence of certain health conditions, the demand for specific services, and the overall utilisation of PHC. For instance, Saudi Arabia has a higher proportion of its population aged less than 19, while the UAE has a larger working-age population(32). These variations in population structure have implications for healthcare demand, notably regarding NCDs. Another element to consider is the differences in the proportion of non-nationals across the six countries(33). In the UAE and Qatar, the population is predominantly composed of non-nationals, whereas KSA has a majority of nationals. To address this particularity, countries have established unique health coverage mechanisms, creating variations in PHC utilisation(34). Lastly, these variations also result from differences in what interventions are delivered at the PHC level as opposed to other healthcare system levels, as well as coverage rates. While these factors demonstrate the complexity of comparing the cost of clinical services delivered at PHC facilities, this study allowed us to identify the main cost drivers and make recommendations. A study conducted in Indonesia in 2020 shares some methodological similarities with this one(35). This study aimed to estimate the costs of reaching national health targets at the primary healthcare level between 2020-2024 using the OneHealth Tool. Nevertheless, a direct comparison between the two studies remains challenging due to significant variations in interventions and

programmes, and the more comprehensive costing approach used by the Indonesian study. These differences highlight the nuanced nature of primary healthcare costing, emphasising the need for context-specific assessments tailored to the unique healthcare landscapes of individual regions or countries.

Generally, the services classified under general practice were the main drivers of the total costs in all countries, followed by services related to preventing, treating, and managing NCDs. The large share of general practice in the total costs can be explained by the many services included within this programme. Costs of services related to NCDs are likely due to the substantial per-patient costs associated with managing these diseases, their chronic nature, and their high prevalence, particularly diabetes, cardiovascular and respiratory diseases, in the six countries. A previous study found that NCDs killed nearly 43,000 people in the Gulf countries in 2019 and generated an economic burden estimated at around US$50 billion, equivalent to 3.3% of the GDP(36). We observed noticeable differences in the proportion of NCD-related costs in the six countries. These differences may stem from various factors, such as the varying proportion of individuals receiving these services in the private healthcare sector or a form of overlapping between the services provided in specialised clinics and general practice. We also observed that the share of costs associated with these services is significantly higher in Qatar (57.4%) than in the five other countries, where it ranges from 6.9% to 19.8%. This factor could be attributed to Qatar being the only country where actual drugs and supplies costs were used in this analysis. Indeed, the actual unit costs provided by Qatar were significantly higher than those extracted from the OneHealth Tool, which were used for the remaining five countries. This suggests that the overall costs for these countries may have been underestimated. However, this could not be verified with the other countries. The substantial contribution of NCD-related services to the total costs modelled also reflects a shift of healthcare demands towards NCDs that countries have been experiencing over the past decades. The GCC countries have made significant strides in the prevention and control of NCDs, most of them having multisectoral coordination mechanisms, comprehensive strategies and targeted programmes(36). For example, the UAE launched 42 NCD clinics between 2017 and 2018 and trained PHC staff in the early detection and management of NCDs(37). Our findings also indicate that mental health services made up between 0.0% and 0.3% of the costs of the selected services. A few countries have taken commendable steps to respond to the increasing prevalence of mental health conditions, such as Bahrain, which established school mental health clinics, implemented a training programme for family physicians, and upgraded its guidelines for mental health(6). However, these programmes did not reach the same level of maturity as other NCD programmes, and ensuring better access to mental health services and reducing the stigma surrounding mental health conditions remain key challenges in the region.

In terms of coverage, the study estimated that approximately 15 million people did not receive necessary NCDs-associated services, and around 9 million people did not receive necessary mental health services at

the public PHC level across all six countries in 2019. As the analysis only modelled the cost of services delivered at the public PHC level, individuals could have received these services in the private sector or at the secondary or tertiary level of the public sector. For example, around 67,000 mental health visits were recorded in Oman through extended healthcare centres in 2019(20), but none were included in our costing model.

We estimated that, across the six countries, around 30 million people did not receive the NCD screening services they required in public PHC. This includes screening for cardiovascular diseases, cervical, breast and colorectal cancers, diabetes and diabetes complications. Additionally, we found that the coverage rates for these seven services were consistently low across the countries, ranging from an average of 4% in Qatar to 7% in Oman. While these results show relatively low access to screening services, they should be qualified by the consideration that screening and awareness-related activities are rarely directly captured in health statistics records and health surveys, making them difficult to estimate accurately.

Limitations

This study had some limitations which must be considered when interpreting the results. Firstly, the list of services included in this study did not include all PHC services. It is also important to note that the selection of services may inadvertently introduce a bias towards NCDs because of the greater representation of these services among those available in the OneHealth Tool Costing Module. To mitigate this potential risk, we actively engaged with the six Ministries of Health during the selection process, allowing them to include additional services. Even if a risk of bias remains, we considered the greater representation of NCD-related services to reflect the current activity and priorities of the public PHC in each country. Secondly, it is important to note that services included in the general practice programme could potentially overlap with other programmes. Challenges related to clearly delineating this programme in each of the six countries introduce uncertainty regarding the distribution of the costs per programme. Thirdly, the drugs and supply costs for each clinical service were estimated using cost assumptions from the OneHealth Tool Costing Module, except for Qatar where primary data was collected. Fourthly, service coverage data was not always available, which required making assumptions based on similar interventions or available data from neighbouring countries. The coverage rates must be interpreted with caution as they only reflect the number of services delivered at the public PHC level, and some services may also be delivered at other levels of the public health system and/or in the private sector. Moreover, without detailed information on the proportion of individuals utilising private care instead of public care, it becomes challenging to fully contextualise and evaluate the coverage rates. Fifthly, the study did not have information on overhead costs such as training, programme management, supervision, monitoring and evaluation, communication, infrastructure and equipment, transportation, and advocacy, and an estimation of 20% of the total costs

was agreed upon to account for this. Finally, comparisons between countries and with other published estimates of PHC spending should be made with caution due to differences in the number and nature of the clinical services included for each country, variations in the healthcare system and population structure, and different data sources used.

Recommendations

The significance of robust PHC in establishing effective and efficient health systems is well acknowledged by all six GCC countries. They have made commendable strides in strengthening PHC by adapting to the evolving disease burden of their populations, as evident from the allocation of substantial costs to NCD services in this study. The comprehensive costing analysis presented in this report sheds light on specific areas where further enhancements in PHC services and resource allocation across the GCC countries can be made. To reap substantial health and economic advantages, the following recommended actions deserve consideration:

1. **Strengthen the primary health workforce:** To address the shortage of skilled healthcare professionals in the primary care sector, the GCC countries should focus on increasing investment in training, attracting, and retaining local Family Physicians (FPs) and General Practitioners (GPs). This can be achieved through incentivising primary care training programmes, such as providing scholarships for nationals pursuing careers in primary care professions. Scaling up the primary health workforce will involve initial and ongoing training and remuneration costs, but the potential health and economic gains justify this investment.

2. **Expand NCD prevention and screening services:** Investing in disease prevention and routine screening services at the public PHC level is vital for strong PHC. The GCC countries have an opportunity to scale up their screening services for NCDs in public PHC, as over 30 million people in the region did not receive the required NCD screening services in 2019. To assess coverage fully, further research into private sector service provision and primary care coverage in the GCC countries is recommended. Scale-up of PHC services should be done with a focus on accessibility, equity, and achieving universal health coverage.

3. **Scale-up mental health services:** Despite progress in ensuring access to mental health services and reducing stigma, the majority of mental health services are still delivered at the secondary or tertiary level in the GCC region. Integrating mental health screening and care services into public PHC, especially in general practice, can improve accessibility and lead to better health outcomes compared to treatment at higher-level facilities. Scaling up mental health services at the PHC level

aligns with a people-centered approach to PHC that addresses health and disease comprehensively.

4. **Enhance regional collaboration and policy coherence:** The GCC countries share common challenges and opportunities in strengthening PHC. Establishing a GCC PHC Coordination Committee with regular meetings to share best practices, lessons learned, and promote legislative action will support regional collaboration. The committee should focus on NCD prevention, screening, and treatment at the PHC level, and consider establishing a database to track progress and emerging challenges in NCD-related targets and indicators. Regional strategies and action plans should be developed to further promote policy coherence and collaboration.

5. **Invest in research and monitoring of PHC:** To improve the efficiency and health outcomes of PHC systems in the GCC region, there should be a focus on research and monitoring. By integrating an effectiveness perspective into this research, GCC countries could identify quick wins, as well as areas and services that require more resources or could be run more efficiently. Scaling up research and monitoring into PHC will provide a stronger evidence base and enable assessment of the impact of potential changes in PHC service delivery. Additionally, defining UHC health benefits packages will facilitate modelling costs associated with the included services.

By implementing these recommendations, the GCC countries can strengthen their PHC systems, leading to improved health outcomes and more efficient resource allocation. These actions will contribute to building effective and robust health systems that effectively address the changing disease burden of the population.

CONCLUSION

To our knowledge, this study is the first that aimed to estimate the costs of services delivered at PHC in the GCC countries. The findings indicate that general practice, child health, and NCDs, particularly diabetes, cardiovascular and respiratory diseases, were the main cost drivers. This study also shows that, in all countries, a significant number of individuals didn't receive essential services, such as screening for NCDs or mental health services, at the public PHC level. Based on these results, we recommend actions to increase the availability and accessibility of prevention and screening services, integrate mental health screening and care services into primary care, and expand research and monitoring efforts on PHC investment, both in the public and private sectors.

Abbreviations

FP	Family Physician
GCC	Gulf Cooperation Council
CHE	Current Health Expenditures
GHE	Government Health Expenditures
KSA	Kingdom of Saudi Arabia
PHC	Primary Healthcare
PHCC	Primary Healthcare Coorporation
NCD	Non-Communicable Disease
UAE	United Arab Emirates
UHC	Universal Health Coverage
WHO	World Health Organization

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Competing Interests

The authors alone are responsible for the views expressed in this article, and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated.

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Contributors

KE and SP substantially contributed to the conception, methodology development and data collection; conducted the data analysis, economic modelling and interpretation of data; and drafted the manuscript. DG, JJ, RG, and RS substantially contributed to the conception and design, literature search, data collection, interpretation of data and drafting of the manuscript. TA, MM, LS, MA, ZA, SA, SF, HRS, and MA contributed to data collection and interpretation of data and revised the article critically for important intellectual content. LM, DA, YA, NB, and DT contributed to the conception and design, provided guidance on scope and interpretation of results, and revised the article critically for important intellectual content. KE, SP and DG are responsible for the overall content as guarantors. All authors approved the version of the manuscript to be published.

Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information.

Ethics statements

Ethics approval was not required for this economic evaluation study. We used publicly accessible documents and data to conduct the economic analysis.

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

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Economics of Primary Healthcare: Cost Estimation of Clinical Services at Primary Care Facilities in The Six Countries of The Gulf Cooperation Council.

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Supplementary Materials

Table S1. List of selected services by country

Service	Bahrain	KSA	Kuwait	Oman	Qatar	UAE
Immunization						
Anti-rabies			X			
BCG vaccine	X	X	X	X	X	X
DPT vaccine	X		X	X	X	X
DT Adult			X			
DT paediatrics			X			
Heb B vaccine (paediatrics)			X			
Hep B vaccine	X				X	X
Hib vaccine	X				X	X
HPV vaccine		X				X
Influenza vaccine	X		X		X	X
Measles vaccine	X	X	X	X	X	X
Meningococcal vaccine			X			
Pentavalent vaccine		X	X	X		
Pneumococcal vaccine	X	X	X	X	X	X
Polio vaccine	X	X	X	X	X	X
Rotavirus vaccine	X		X		X	X
Rubella vaccine		X				
TT			X			
Varicella vaccine	X	X	X	X	X	
Non-Communicable Diseases						
Breast Cancer						
Basic breast cancer awareness	X	X	X	X	X	X
Diagnosis after screened with clinical breast exam			X	X		X
Diagnosis after screened with mammography						X
Diagnosis without screening for breast cancer						X
Diagnosis: screened with clinical breast exam		X				

Diagnosis: screened with mammogram		X				
Post-treatment surveillance for breast cancer patients		X				
Screening: clinical breast examination	X	X	X	X	X	X
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Screening: mammography		X				X
Cervical Cancer						
HPV DNA + VIA						X
Papanicolaou test (pap smear)	X	X	X	X	X	X
Post-treatment surveillance for cervical cancer		X				
Visual inspection with acetic acid (VIA)						X
Colorectal Cancer						
Diagnosis for colorectal cancer screened with FIT						X
Diagnosis for colorectal cancer screened with FOBT		X				X
Diagnosis without screening for colorectal cancer (symptom based)		X				X
Post-treatment surveillance for colorectal cancer		X				
Screening: colonoscopy		X				
Screening: faecal immunochemical test						X
Screening: faecal occult blood testing	X	X	X	X	X	X
Screening: sigmoidoscopy		X				
CVD & Diabetes						
Follow-up care for those at low risk of CVD/Diabetes (absolute Risk: 10-20%)	X	X	X	X	X	X
Intensive glycaemic control	X	X	X	X	X	X
Neuropathy screening and preventive foot care	X	X	X	X	X	X
Referral for retinopathy screening				X		
Retinopathy screening	X		X		X	X
Screening for risk of CVD/Diabetes	X	X	X	X	X	X
Standard glycaemic control	X	X	X	X	X	X
Treatment for those with absolute risk of CVD/Diabetes 20-30%	X	X	X	X	X	X
Treatment for those with established cerebrovascular disease and post stroke	X	X	X	X	X	X
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	X	X	X	X	X	X
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	X	X	X	X	X	X
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	X	X	X	X	X	X
Treatment of cases with established ischaemic heart disease (IHD)	X	X	X	X	X	X
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	X	X			X	X
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	X	X	X	X	X	X
Emergency care						
Average annual emergency care needs	X	X	X	X	X	X
Oral Care						

Dental cleaning and preventive care	X	X	X	X	X	
Oral and dental care						X
Respiratory Diseases						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Asthma: high dose inhaled beclomethasone + SABA	X		X		X	X
Asthma: high dose inhaled fluticasone + SABA		X		X		
Asthma: inhaled short acting beta agonist for intermittent asthma	X	X	X	X	X	X
Asthma: low dose inhaled beclomethasone + SABA	X		X		X	X
Asthma: low dose inhaled fluticasone + SABA		X		X		
Asthma: oral prednisolone + theophylline + high dose inhaled fluticasone + SABA		X		X		
Asthma: theophylline + high dose inhaled fluticasone + SABA		X		X		
COPD: exacerbation treatment with antibiotics	X	X	X	X	X	X
COPD: exacerbation treatment with oral prednisolone	X	X	X	X	X	X
COPD: exacerbation treatment with oxygen		X		X		X
COPD: inhaled salbutamol	X	X	X	X	X	X
COPD: ipratropium inhaler	X	X	X	X	X	X
COPD: low-dose oral theophylline	X	X	X	X	X	
COPD: smoking cessation	X	X	X	X	X	X
Child Health						
Deworming						
Deworming	X		X	X	X	
Diarrhea management						
Antibiotics for treatment of dysentery		X		X		X
ORS	X	X	X	X	X	X
Treatment of severe diarrhea		X				
Zinc (diarrhea treatment)		X		X		
General						
Zinc supplementation		X		X		
Child general health	X	X	X	X	X	X
School health	X				X	
Malaria						
Malaria treatment (0-4, mild cases)				X		
Pneumonia						
Pneumonia treatment (children)	X	X	X	X	X	X
Treatment of severe pneumonia		X				
Routine Child Health Care Visit						
Routine child health care visit (< 1 year)						X
Routine child health care visit (1-5 years)						X
School Health Program						

Dental screening				X		
Ear screening				X		
Eye screening				X		
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Nutrition						
Adults						
Care for adults with food allergies and sensitivities						X
Care for adults with hyperuricemia						X
Care for adults with kidney diseases						X
Care for adults with low BMI	X	X	X	X	X	
Care for adults with nutritional anaemia						X
Care for adults with other nutritional diseases						
Care for diabetic adults						X
Care for obese adults						X
All populations						
Food fortification						X
Children						
Breastfeeding counselling and support	X	X	X	X	X	
Complementary feeding counselling and support	X	X	X	X		
Feeding counselling and support for infants and young children in emergency situations						
Intermittent iron supplementation in children	X		X	X	X	
Management of food allergies or food intolerances						X
Management of moderate acute malnutrition						X
Management of moderate acute malnutrition (children)		X		X		
Management of severe malnutrition						X
Pregnant and lactating women						
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia				X		
Daily FAF, postpartum, anaemic women				X		
Daily iron and folic acid supplementation (pregnant women)	X	X	X	X	X	
Intermittent FAF, postpartum, non-anaemic pregnant women				X		
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	X	X	X	X	X	
Iodine supplementation in pregnant women		X				
Vitamin A supplementation in pregnant women		X				
Women of reproductive age and adolescent girls						
Intermittent iron-folic acid supplementation	X	X	X	X	X	
Mental Health						
Alcohol use/ dependence						
Identification and assessment of new cases of alcohol use/dependence				X		X

Brief interventions and follow-up for alcohol use/dependence		X		X		
Identification and assessment of new cases of alcohol use/dependence		X				
Anxiety Disorders						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Basic psychological treatment for anxiety disorders (mild cases).	X		X	X	X	X
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (mild-moderate cases)	X	X	X		X	X
Basic psychosocial treatment for anxiety disorders (mild cases)		X				
Attention Disorders						
Methylphenidate medication						X
Bipolar Disorders						
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication		X				X
Conduct Disorders						
Basic psychosocial treatment, advice, and follow-up for behavioural disorders		X				X
Dementia						
Assessment, diagnosis, advice, and follow-up for dementia		X				X
Dementia screening, basic work up and referral to tertiary care				X		
Pharmacological treatment of dementia						X
Depression						
Basic psychosocial treatment and anti-depressant medication of first episode (mild to moderate cases)				X		
Basic psychosocial treatment and anti-depressant medication of first episode (moderate-severe cases)	X	X	X		X	X
Basic psychosocial treatment for mild depression	X	X	X	X	X	X
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis						X
Psychosocial care for perinatal depression						X
Psychosocial care for perinatal depression for mild cases only				X		
Developmental Disorders						
Basic psychosocial treatment, advice, and follow-up for developmental disorders		X				X
Drug use/dependence						
Brief interventions and follow-up for drug use/dependence		X		X		X
Identification and assessment of new cases of drug use/dependence		X		X		
Epilepsy						
Basic psychosocial support, advice, and follow-up only				X		
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication		X				X
Psychosis						
Basic psychosocial support and anti-psychotic medication		X		X		X
Self-harm/suicide						
Assess and care for person with self-harm		X		X		

Basic psychosocial treatment, advice, and follow-up for self-harm/suicide				X		
Pesticide intoxication management				X		
Maternal Newborn and Reproductive Health						
Antenatal Care (ANC)						
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Antenatal Care (ANC)						X
Childbirth care - Facility births						
Feeding counselling and support for low-birth-weight infants				X		
Kangaroo mother care				X		
Labour and delivery management				X		
Manual removal of placenta				X		
MgSO4 for eclampsia				X		
Neonatal resuscitation				X		
Parenteral administration of uterotonics				X		
Pre-referral management of labour complications		X		X		
Treatment of local infections (newborn)				X		
Family planning						
Condom - male				X		
Contraception management					X	
Implant - Implanon (3 years)				X		
Injectable - 3 month (depo provera)	X		X	X		
IUCD follow-up care	X		X		X	
IUD - Copper-T 380-A IUD (10 years)		X		X		
Lactational amenorrhea method				X		
Other contraceptives	X		X			
Periodic abstinence				X		
Pill - progestin only	X		X	X		
Pill - standard daily regimen		X				
Standard days method				X		
Withdrawal		X		X		
Post-abortion case management			X		X	
Management of ectopic pregnancy care						
Ectopic case management				X		
Menopause Program						
Screen for mood disorders				X		
Screen for urogenital dryness				X		
Other						
Postmenopausal care			X			
Management of abnormal uterine bleeding			X			

Management of amenorrhea			X			
Management of hirsutism			X			
Management of irregular cycles			X			
Management of mild endometriosis			X			
Service	**Bahrain**	**KSA**	**Kuwait**	**Oman**	**Qatar**	**UAE**
Management of PCO			X			
Management of pre pubertal problems (delayed menarche, infection)			X			
Other sexual and reproductive health						
Cervical cancer screening		X	X			
Identification and management of infertility	X	X	X	X	X	
Treatment of chlamydia	X	X	X	X	X	
Treatment of gonorrhoea	X	X	X	X	X	
Treatment of pelvic inflammatory disease	X	X	X	X	X	
Treatment of syphilis	X	X	X	X	X	
Treatment of trichomoniasis	X	X	X	X	X	
Treatment of urinary tract infection	X	X	X	X	X	
Postpartum Care						
Breast feeding education and advice	X		X		X	
Mastitis	X		X	X		
Postnatal care						X
Postpartum care examination					X	
Treatment of postpartum haemorrhage	X	X	X	X	X	
Maternal sepsis case management				X		
Preconception Care (PCC)						
Preconception care						X
Pregnancy Care						
Basic ANC	X	X	X	X	X	
Syphilis detection and treatment (pregnant women)	X		X		X	
Tetanus toxoid (pregnant women)	X	X	X	X	X	
Syphilis screening (pregnant women)				X		
Pregnancy care - Treatment of pregnancy complications						
Deworming (pregnant women)	X		X	X		
Hypertensive disorder case management		X		X		
Management of other pregnancy complications				X		
Management of pre-eclampsia (magnesium sulphate)				X		
Premarital screening program						
Premarital screening program						X
General Practice						
General practice	X	X	X	X	X	X

Table S2. Assumptions used to estimate the population in need, drugs and supplies costs, and labour costs (all countries)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Varicella vaccine	Children 1 and 5 years old, for the first and the second dose	USD 17.5 for one dose (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Influenza vaccine	Children 0-5 + Pregnant women + People 65+	USD 2.39 for one dose (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Retinopathy screening	People with diabetes should be screened every year (100%)	-	-
Neuropathy screening	People with diabetes should be screened every year (100%)	-	-
Clinical breast examination	Women aged 40-70 should be screened every 2 years (50%)	-	-
Diagnosis after screened with clinical breast examination	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Pap smear	Women 30-49 should be screened every 3 years (33%)	-	-
Faecal occult blood screening	People 50+ should be screened every 10 years (10%)	-	-
Dental cleaning and preventive care	All population	No costs estimated	Nurse (20 min) and Dentist (15 min) for one visit
General child health	Children 0-14	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
Pneumonia treatment	-	-	Nurse (20 min) + GP (20 min) for one visit
Daily iron and folic acid supplementation (anaemic pregnant women)	100% of anaemic pregnant women (World Bank)	-	-
Intermittent iron folic acid supplementation (non-anaemic pregnant women)	100% of non-anaemic pregnant women (World Bank)	-	-
Daily FAF, postpartum, non-anaemic women	Based on number of live births (Annual Health Statistics) and percentage of anaemic women (World Bank)		

Intermittent FAF, postpartum, anaemic women	Based on number of live births (Annual Health Statistics) and percentage of non-anaemic women (World Bank)		
Care for adults with low BMI	100% of underweight adults (Global Nutrition Report)	-	-
All mental health clinical services	Based on prevalence rates (Zuberi et al. 2021, GBD 2016 Epilepsy Collaborators, GBD 2016 Dementia Collaborators, WHO-EMRO, Atlas of Substance Disorder).	-	-
Treatment of postpartum haemorrhage (PPH)	Based on incidence rates of PPH	-	-
Identification and management of infertility	Based on regional prevalence (Eldib 2018) among adults 15-49 (3.8%)	-	-
Treatment of syphilis	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (2.2%)	-	-
Treatment of gonorrhoea	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (0.9%)	-	-
Treatment of chlamydia	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (1.9%)	-	-
Treatment of trichomoniasis	Based on regional incidence rates (Kenyon et al. 2014) among adults 15-49 (2.8%)	-	-
Treatment of pelvic inflammatory infection	Based on US incidence rate (Kresiel 2021) among adults 15-49 (3.6%)	-	-
General practice	All population	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
All Services	-	-	Community health workers time was allocated to nurses

Table S2-A. Country-specific assumptions (Oman)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
School health program (eye screening)	Children in grade 1, 4, 7 and 10	No costs estimated	Nurse (10 min) for one visit
School health program (dental screening)	Children in grade 1	No costs estimated	Nurse (10 min) for one visit

School health program (ear screening)	Children in grade 1 and 2	No costs estimated	Nurse (10 min) for one visit
Menopause program: screen for urogenital dryness, screen for mood disorders	Women 45-55 (100%)	No costs estimated	GP (15 min) for one visit
Elderly and community care program	People 60+	No costs estimated	Nurse (45 min) for one visit

Table S2-B. Country-specific assumptions (Bahrain)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
School health	Children 5-19	No costs estimated	Nurse (10 min) for one visit

Table S2-C. Country-specific assumptions (Kuwait)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Meningococcal vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 10.6 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
DT adult vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 1.8 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
DT pediatrics vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 1.8 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Anti-rabies vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 48.6 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Hep B vaccine (paediatrics)	PIN was not estimated since the number of visits was directly provided by MOH	USD 3.24 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
TT vaccine	PIN was not estimated since the number of visits was directly provided by MOH	USD 0.58 (WHO Review of vaccine price data)	Nurse (4 min) and GP (4 min) for one dose
Management of pre-pubertal problems	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Obs/Gyn (15 min) for one visit
Management of PCO, hirsutism, irregular cycles, amenorrhea, abnormal uterine bleeding, management of mild endometriosis, postmenopausal care	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Obs/Gyn (15 min) for one visit

Table S2-D. Country-specific assumptions (Qatar)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Child General Health	Children 0-14	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (15 min) for one visit
School health	PIN was not estimated since the number of visits was directly provided by MOH	No costs estimated	Nurse (10 min) for one visit
Postpartum care examination	PIN was not estimated since the number of visits was directly provided by MOH	Cost per outpatient visit (WHO-CHOICE) – Labour costs	GP (10 min) and Midwife (20 min) for one visit
Allied health	PIN was not estimated since the number of visits was directly provided by MOH	Cost per outpatient visit (WHO-CHOICE) – Labour costs	Nurse (20 min) for one visit

Table S2-E. Country-specific assumptions (UAE)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Screening: mammography	Women aged 40-70 should be screened every 2 years (50%)	-	-
Diagnosis for breast cancer	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Visual inspection with acetic acid, HPV DNA + VIA.	Based on country cervix cancer incidence rate (WHO – IARC 2020)	-	-
Screening; faecal immunochemical test	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-
Diagnosis for colorectal cancer	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-
Routine child healthcare visit (1 year)	Children 0-12 months (100%)	Estimate based on OHT drugs and supplies prices: USD 19.7	Nurse (20 min), GP (10 min)
Routine child healthcare visit (1-5 years)	Children 12-59 months (100%)	Estimate based on OHT drugs and supplies prices: USD 2.8	Nurse (20 min), GP (10 min)
Nutrition: Care for obese adults	People with obesity (Global Nutrition Report)	No costs estimated	GP (10 min)
Nutrition: Care for diabetic adults	People with diabetes (OHT)	No costs estimated	GP (10 min)

Nutrition: Care for adults with kidney diseases	Adults with chronic kidney disease (Al-Shamsi et al. 2018)	No costs estimated	GP (10 min)
Nutrition: Care for adults with nutritional anaemia	Adults with anaemia (Global Nutrition Report)	No costs estimated	GP (10 min)
Nutrition: Care for adults with food allergies and sensitivities	People with nutrition-related allergies (Althumiri et al. 2021)	No costs estimated	GP (10 min), Specialist Doctor (30 min)
Management of food allergies and food intolerance	Children 0-14 x Global Prevalence of Allergies (3.0%)	No costs estimated	GP (10 min), Specialist Doctor (30 min)
Preconception care	Married women or planning for marriage at reproductive age (15-49 years)	Estimate based on OHT drugs and supplies prices: USD 4.90	Nurse (15 min), GP (15 min)
Antenatal care	Pregnant women	Estimate based on OHT drugs and supplies prices: USD 36.42	GP (40 min), Radiographer (20 min), Midwife (40 min)
Postnatal care	Women who gave birth	No costs estimated	Nurse (15 min), GP (15 min)
Premarital screening program	Women (15-49) planning for a marriage	Estimate based on OHT drugs and supplies prices: USD 15.66	Nurse (15 min), GP (15 min)

Table S2-F. Country-specific assumptions (KSA)

Service	Population in Need	Drugs and Supply Costs	Labour Costs
Screening: mammography	Women aged 40-70 should be screened every 2 years (50%)	-	-
Post-treatment surveillance for breast cancer patients	Based on country breast cancer incidence rate (WHO – IARC 2020)	-	-
Post treatment surveillance for cervical cancer	Based on country cervix cancer incidence rate (WHO – IARC 2020)	-	-
Screening: Sigmoidoscopy, colonoscopy	People 50+ should be screened every 10 years (10%)	-	-
Post treatment surveillance for colorectal cancer	Based on country colorectal cancer incidence rate (WHO – IARC 2020)	-	-

Table S3. References and assumptions used to estimate the total number of services delivered in 2019 in Oman

Immunization	Reference / Assumption
Measles vaccine	MOH Health Statistics 2019[1]
Pentavalent vaccine	
Varicella vaccine	
DPT vaccination	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs[2]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[1]
Intensive glycaemic control	
Referral for retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: clinical breast examination (CBE)	MOH Health Statistics[1]
Diagnosis after screened with clinical breast exam	Assumption derived from WHO-IARC 2020[3]
Cervical Cancer	
Papanicolaou test (pap smear)	Assumption derived from Bahrain CR
Colorectal Cancer	
Screening: faecal occult blood testing	Assumption derived from 'CBE'
Elderly and community care program	
Elderly and community care program	MOH Health Statistics 2019[1]
Respiratory Disease	

Asthma: Inhaled short acting beta agonist for intermittent asthma	MOH Health Statistics 2019[1]
Asthma: Low dose inhaled fluticasone + SABA	
Asthma: High dose inhaled fluticasone + SABA	
Asthma: Theophylline + High dose inhaled fluticasone + SABA	
Asthma: Oral Prednisolone + Theophylline + High dose inhaled fluticasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: Exacerbation treatment with antibiotics	
COPD: Exacerbation treatment with oral prednisolone	
COPD: Exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General	
Child general health	Assumption: 25% of GP visits (MOH Health Statistics 2019[1])
Deworming	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc supplementation	
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc (diarrhea treatment)	
Antibiotics for treatment of dysentery	
Pneumonia	
Pneumonia treatment (children, mild cases)	Estimate from MOH Health Statistics 2019[1]
Malaria	
Malaria treatment (0-4, mild cases)	Estimate from MOH Health Statistics 2019[1]
School Health Program	
Eye screening	MOH Health Statistics 2019[1]
Dental screening	
Ear screening	
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 5%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from MOH Health Statistics 2019[1]

Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Calcium supplementation for prevention and treatment of pre-eclampsia and eclampsia	
Daily FAF, postpartum, anaemic women	Estimate from MOH Health Statistics 2019[1]
Intermittent FAF, postpartum, non-anaemic pregnant women	
Adults	
Care for adults with low BMI	Assumption: 2.5%
Children	
Breastfeeding counselling and support	MOH Health Statistics 2019[1]
Complementary feeding counselling and support	Assumption derived from UHC Service Coverage Index (WHO)[2]
Intermittent iron supplementation in children	
Management of moderate acute malnutrition (children)	MOH Health Statistics 2019[1]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (mild to moderate cases)	
Depression	
Basic psychosocial treatment for mild depression	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment and anti-depressant medication of first episode (mild to moderate cases)	
Psychosocial care for peri-natal depression for mild cases only	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Estimate from MOH Health Statistics 2019[1]
Epilepsy	
Basic psychosocial support, advice, and follow-up only	Estimate from MOH Health Statistics 2019[1]
Dementia	
Dementia screening, basic work up and referral to tertiary care	Estimate from MOH Health Statistics 2019[1]
Alcohol use/ dependence	
Identification and assessment of new cases of alcohol use/dependence	Estimate from MOH Health Statistics 2019[1]
Brief interventions and follow-up for alcohol use/dependence	
Drug use/dependence	
Identification and assessment of new cases of drug use/dependence	Estimate from MOH Health Statistics 2019[1]
Brief interventions and follow-up for drug use/dependence	
Self-harm/suicide	
Assess and care for person with self-harm	Estimate from MOH Health Statistics 2019[1]
Basic psychosocial treatment, advice, and follow-up for self-harm/suicide	
Pesticide intoxication management	
Maternal Newborn and Reproductive Health	

Family planning	
Pill - Progestin only	MOH Health Statistics 2019[1]
Condom - Male	
Injectable - 3 month (Depo Provera)	
IUD - Copper-T 380-A IUD (10 years)	
Implant - Implanon (3 years)	Assumption: 0.5%
LAM (Lactational Amenorrhea Method)	MOH Health Statistics 2019[1]
SDM (Standard Days Method)	
Periodic abstinence	
Withdrawal	
Management of ectopic pregnancy care	
Ectopic case management	Assumption: 100%
Pregnancy care - ANC	
Tetanus toxoid (pregnant women)	Estimate from MOH Health Statistics 2019[1]
Syphilis screening (pregnant women)	MOH Health Statistics 2019[1]
Basic ANC	
Pregnancy care - Treatment of pregnancy complications	
Hypertensive disorder case management	Assumption: 99%
Management of pre-eclampsia (Magnesium sulphate)	
Management of other pregnancy complications	
Deworming (pregnant women), part of general care and not specific for pregnant women	Assumption derived from UHC Service Coverage Sub-Index on RMNH (WHO)[2]
Childbirth care - Facility births	
Parenteral administration of uterotonics	Estimate from MOH Health Statistics 2019[1]
Labour and delivery management	
Pre-referral management of labour complications	
MgSO4 for eclampsia	
Neonatal resuscitation	
Treatment of local infections (newborn)	
Kangaroo mother care	
Feeding counselling and support for low-birth-weight infants	
Manual removal of placenta	
Postpartum care - Treatment of sepsis	
Maternal sepsis case management	Estimate from MOH Health Statistics 2019[1]
Postpartum care - Other	
Mastitis	Estimate from UHC Service Coverage Sub-Index on RMNH (WHO)[2]
Treatment of postpartum haemorrhage	Assumption: 100%

Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	MOH Health Statistics 2019[1]
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)- mild cases only	
Menopause Program	
Screen for urogenital dryness	Assumption: 7.5%
Screen for mood disorders	Assumption: 7.5%
General Practice	
General Practice	Estimate from MOH Health Statistics 2019[1]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[1]

Table S4. References and assumptions used to estimate the total number of services delivered in 2019 in Bahrain

Immunization	
Rotavirus vaccine	MOH Health Statistics 2019[4]
Measles vaccine	
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	Estimate from MOH Health Statistics 2019[4]
Influenza vaccine	MOH Health Statistics 2019[4]
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Estimate from MOH Health Statistics 2019[4]
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	

Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[4]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: clinical breast examination (CBE)	MOH Health Statistics 2019[4]
Cervical Cancer	
Papanicolaou test (pap smear)	MOH Health Statistics 2019[4]
Colorectal Cancer	
Screening: faecal occult blood testing	Estimate from 'CBE' and 'pap smear'
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Asthma: low dose inhaled beclomethasone + SABA	
Asthma: high dose inhaled beclomethasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General Health	
Child general health	Assumption: 25% of total number of GP Visit (MOH Health Statistics 2019[4])
School Health	
School Health	MOH Health Statistics 2019[4]
Deworming	
Deworming	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Diarrhea management	

ORS	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Sub-Index on Infectious Disease (WHO)[2]
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 5.0%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Estimate from MOH Health Statistics 2019[4]
Children	
Breastfeeding counselling and support	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Complementary feeding counselling and support	
Intermittent iron supplementation in children	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	Estimate from MOH Health Statistics 2019[4]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	Estimate from MOH Health Statistics 2019[4]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Pill - Progestin only	United Nations 2019[5]
Injectable - 3 month (Depo Provera)	
Other contraceptives	
IUCD follow-up care	Assumption derived from UHC Service Coverage Index (WHO)[2]
Pregnancy Care	
Tetanus toxoid (pregnant women)	Estimate from MOH Health Statistics 2019[4]
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Pregnancy care - Treatment of pregnancy complications	
Deworming (pregnant women)	Assumption: 100%
Postpartum care - Other	

Mastitis	Assumption derived from UHC Service Coverage Sub-Index on RMCH (WHO)[2]
Breast feeding education and advices	
Treatment of postpartum haemorrhage	Assumption: 100%
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	MOH Health Statistics 2019[4]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[4]

Table S5. References and assumptions used to estimate the total number of services delivered in 2019 in Kuwait

Immunization	
Rotavirus vaccine	MOH Health Statistics 2019[6]
Measles vaccine	
Pentavalent vaccine	
DPT vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	
DT Adult	
Measles vaccine	Provided by MOH
Varicella vaccine	
Influenza vaccine	
Meningococcal vaccine	
DT paediatrics	
Anti-Rabies	
Heb B vaccine (paediatrics)	
TT	

Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: CR = 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	Provided by MOH
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Standard glycaemic control	Estimate from MOH Health Statistics 2019[6]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: CR = 5.0%
Screening: clinical breast examination	Assumption derived from Oman
Diagnosis after screened with clinical breast exam	Estimate from WHO-IARC 2020[3]
Cervical Cancer	
Papanicolaou test (pap smear)	Provided by MOH
Colorectal Cancer	
Screening: faecal occult blood testing	Provided by MOH
Respiratory Disease	
Asthma: inhaled short acting beta agonist for intermittent asthma	Estimation from data provided by MOH
Asthma: low dose inhaled beclomethasone + SABA	
Asthma: high dose inhaled beclomethasone + SABA	
COPD: smoking cessation	
COPD: inhaled salbutamol	
COPD: low-dose oral theophylline	
COPD: ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	

General Health	
Child general health	MOH Health Statistics 2019[6]
Deworming	
Deworming	Provided by MOH
Diarrhea management	
ORS	Estimate based on data provided by MOH
Pneumonia	
Pneumonia treatment (children)	Provided by MOH
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Estimate from data provided by MOH
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Assumption derived from UHC Service Coverage Sub-Index on MRCH (WHO)[2]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Assumption derived from Bahrain
Children	
Breastfeeding counselling and support	Assumption derived from UHC Service Coverage Sub-Index on MRCH (WHO)[2]
Complementary feeding counselling and support	
Intermittent iron supplementation in children	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	OneHealth Tool[7]
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	OneHealth Tool[7]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Pill - Progestin only	United Nations 2019[5]
Injectable - 3 month (depo provera)	
Other contraceptives	
IUCD follow-up care	Assumption derived from UHC Service Coverage Index (WHO)[2]
Management of abortion complications	
Post-abortion case management	Assumption (70.0%)
Pregnancy Care	

Tetanus toxoid (pregnant women)	Estimate based on data provided by MOH.
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Pregnancy care - Treatment of pregnancy complications	
Deworming (pregnant women)	Assumption (100.0%)
Postpartum care - Other	
Mastitis	Assumption derived from UHC Service Coverage Index (WHO)[2]
Breast feeding education and advices	
Treatment of postpartum haemorrhage	Estimate based on data provided by MOH.
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Provided by MOH
Cervical cancer screening	
Identification and management of infertility	
Treatment of syphilis	Estimate based on data provided by MOH
Treatment of gonorrhea	Provided by MOH
Treatment of chlamydia	Estimate based on data provided by MOH
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	Provided by MOH
Other	
Management of pre pubertal problems	Provided by MOH
Management of PCO	
Management of hirsutism	Estimate based on data provided by MOH
Management of irregular cycles	Provided by MOH
Management of amenorrhea	
Management of abnormal uterine bleeding	
Management of mild endometriosis	
Postmenopausal care	
General Practice	
General Practice	MOH Health Statistics 2019[6]
Oral Care	
Dental cleaning and preventive care	MOH Health Statistics 2019[6]

Table S6. References and assumptions used to estimate the total number of services delivered in 2019 in Qatar

Immunization	
Rotavirus vaccine	Global Health Observatory (WHO)[2]
Measles vaccine	Qatar Health Statistics 2019[8]
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	
Varicella vaccine	Estimate from Qatar Health Statistics 2019[8]
Influenza vaccine	Assumption derived from GCC countries
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Estimate from PHCC Official Statistics
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	
Intensive glycaemic control	
Retinopathy screening	Assumption: 1%
Neuropathy screening and preventive foot care	Assumption: 1%
Breast Cancer	
Basic breast cancer awareness	Assumption: 5%
Screening: Clinical Breast Examination	Assumption derived from GCC countries and PHCC Official Statistics
Cervical Cancer	
Papanicolaou test (Pap smear)	Assumption derived from GCC countries and PHCC Official Statistics
Colorectal Cancer	
Screening: Fecal occult blood testing	Assumption derived from GCC countries and PHCC Official Statistics
Allied Health	
Allied Health	PHCC Official Statistics

Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	PHCC Official Statistics
Asthma: Low dose inhaled beclomethasone + SABA	
Asthma: High dose inhaled beclomethasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Low-dose oral theophylline	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General Health	
Child General Health	Estimate from PHCC Official Statistics
General Health	
School Health	PHCC Official Statistics
Deworming	
Deworming	PHCC Official Statistics
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index for Infectious Diseases[2]
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Index for Infectious Diseases[2]
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Assumption: 50%
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from data provided by PHCC Official Statistics and World Bank[9]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	
Adults	
Care for adults with low BMI	Assumption: 2.5%
Children	
Breastfeeding counselling and support	Assumption: 70%
Intermittent iron supplementation in children	Assumption derived from Zainel et al. (2018)[10]
Mental Health	
Anxiety Disorders	
Basic psychological treatment for anxiety disorders (mild cases).	PHCC Official Statistics
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	

Basic psychosocial treatment for mild depression	PHCC Official Statistics
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Maternal Newborn and Reproductive Health	
Family planning	
Contraception Management	Estimate from PHCC Official Statistics
Management of abortion complications	
Post-abortion case management	Estimate from PHCC Official Statistics
Pregnancy Care	
Tetanus toxoid (pregnant women)	Estimate from PHCC Official Statistics
Syphilis detection and treatment (pregnant women)	
Basic ANC	
Breast feeding education and advices	
Postpartum care - Other	
Postpartum Care Examination	PHCC Official Statistics
Treatment of postpartum haemorrhage	
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	PHCC Official Statistics
Identification and management of infertility	
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	PHCC Official Statistics
Oral Care and Cancer	
Dental cleaning and preventive care	PHCC Official Statistics

Table S7. References and assumptions used to estimate the total number of services delivered in 2019 in UAE

Immunization	
Rotavirus vaccine	WHO-UNICEF Estimates 2019[11]
Measles vaccine	
DPT vaccine	
Hib vaccine	
Hep B vaccine	
Polio vaccine	
BCG vaccine	
Pneumococcal vaccine	

HPV vaccine	HPV Information Centre[12]
Influenza vaccine	Assumption derived from Bahrain
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	
Standard glycaemic control	Estimate from OneHealth Tool[7] and Dubai Government Annual Health Statistics Book 2019[13]
Intensive glycaemic control	
Retinopathy screening	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: Clinical Breast Examination	Estimate from Bahrain
Screening: Mammography	Assumption: 0.9%
Diagnosis after Screened with Clinical Breast Exam	Estimation from WHO IARC 2020[3]
Diagnosis after Screened with Mammography	
Diagnosis without screening for breast cancer	
Cervical Cancer	
Visual inspection with acetic acid (VIA)	Assumption: 5.0%
Papanicolaou test (Pap smear)	Assumption: 9.3%
HPV DNA + VIA	Assumption: 5.0%
Colorectal Cancer	
Screening: faecal immunochemical test	Assumption : 0.5%
Screening: faecal occult blood testing	
Diagnosis for colorectal cancer screened with FIT	Assumption: 100%
Diagnosis for colorectal cancer screened with FOBT	
Diagnosis without screening for colorectal cancer (symptom based)	
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[3]
Asthma: Low dose inhaled beclomethasone + SABA	

Asthma: High dose inhaled beclomethasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
COPD: exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Oral Care	
Oral and dental care	Estimate from Dubai Government Annual Health Statistics Book[13]
Child Health	
General Health (Children)	
General Health (Children)	Assumption: 25% of GP visits
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Antibiotics for treatment of dysentery	
Pneumonia	
Pneumonia treatment (children)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Routine Child Health Care Visit	
Routine Child Health Care Visit (< 1 year)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Routine Child Health Care Visit (1-5 years)	
Nutrition	
Adults	
Care for Obese adults	Assumption: 5.0%
Care for Diabetic adults	
Care for adults with hyperuricemia	
Care for adults with kidney diseases	
Care for adults with nutritional anaemia	
Care for adults with food allergies and sensitivities	
All populations	
Food fortification	Assumption: 100%
Children	
Management of severe malnutrition	Assumption derived from UHC Service Coverage Index (WHO)[2]
Management of moderate acute malnutrition	
Management of Food allergies or Food intolerances	Assumption: 5.0%
Mental Health	
Anxiety Disorders	
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	Estimate from Abu Dhabi Government Annual Health Statistics[14]

Basic psychological treatment for anxiety disorders (mild cases).	
Depression	
Basic psychosocial treatment for mild depression	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Intensive psychosocial treatment and anti-depressant medication of recurrent moderate-severe cases on a maintenance basis	
Psychological care for peri-natal	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Bipolar Disorders	
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Epilepsy	
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Developmental Disorders	
Basic psychosocial treatment, advice, and follow-up for developmental disorders	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Conduct Disorders	
Basic psychosocial treatment, advice, and follow-up for behavioural disorders	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Attention Disorders	
Methylphenidate medication	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Dementia	
Assessment, diagnosis, advice, and follow-up for dementia	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Pharmacological treatment of dementia	
Alcohol Use/Dependence	
Identification and assessment of new cases of alcohol use/dependence	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Drug Use/Dependence	
Brief interventions and follow-up for drug use/dependence	Estimate from Abu Dhabi Government Annual Health Statistics[14]
Maternal Newborn and Reproductive Health	
Preconception Care (PCC)	
Preconception Care (PCC)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Antenatal Care (ANC)	
Antenatal Care (ANC)	Assumption: 99% ANC Coverage
Postnatal Care (PNC)	
Postnatal Care (PNC)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Premarital screening program	
Premarital screening program	Assumption: 100%
General Practice	
General Practice	Estimate from Dubai Government Annual Health Statistics Book[13]

Table S8. References and assumptions used to estimate the total number of services delivered in 2019 in KSA

Immunization	
Measles vaccine	MOH Statistical Yearbook 2019[15]
Pentavalent vaccine	
Varicella vaccine	Estimate from MOH Statistical Yearbook 2019[15]
Polio vaccine	MOH Statistical Yearbook 2019[15]
BCG vaccine	
Rubella vaccine	
Pneumococcal vaccine	
HPV vaccine	Assumption: 5.0%
Non-Communicable Diseases	
CVD & Diabetes	
Screening for risk of CVD/Diabetes	Assumption: 5.0%
Follow-up care for those at low risk of CVD/Diabetes (Absolute Risk: 10-20%)	Assumption: 5.0%
Treatment for those with very high cholesterol but low absolute risk of CVD/Diabetes (< 20%)	Estimate from MOH Statistical Yearbook 2019[15]
Treatment for those with high blood pressure but low absolute risk of CVD/Diabetes (< 20%)	
Treatment for those with absolute risk of CVD/Diabetes 20-30%	
Treatment for those with high absolute risk of CVD/Diabetes (>30%)	
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	
Treatment of cases with established ischaemic heart disease (IHD)	
Treatment for those with established cerebrovascular disease and post stroke	KSA World Health Survey[16]
Treatment of cases with rheumatic heart disease (with benzathine penicillin)	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Standard glycaemic control	Estimate from MOH Statistical Yearbook 2019[15]
Intensive glycaemic control	
Neuropathy screening and preventive foot care	
Breast Cancer	
Basic breast cancer awareness	Assumption: 5.0%
Screening: Clinical Breast Examination	Assumption derived from Bahrain
Screening: Mammography	KSA World Health Survey[16]
Diagnosis: Screened with clinical breast exam	Estimate from WHO IARC 2020[3]
Diagnosis: Screened with mammogram	
Post-treatment surveillance for breast cancer patients	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Cervical Cancer	
Papanicolaou test (Pap smear)	KSA World Health Survey[16]
Post treatment surveillance for cervical cancer	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Colorectal Cancer	

Screening: faecal occult blood testing	Estimate from Aljumah and Aljebreen (2017)[17]
Screening: Sigmoidoscopy	
Screening: Colonoscopy	
Diagnosis for colorectal cancer screened with FOBT	Estimation from WHO IARC 2020[3]
Diagnosis without screening for colorectal cancer (symptom based)	
Post treatment surveillance for colorectal cancer	Assumption derived from UHC Service Coverage Sub-Index on NCDs (WHO)[2]
Respiratory Disease	
Asthma: Inhaled short acting beta agonist for intermittent asthma	Estimate from MOH Statistical Yearbook 2019[15]
Asthma: Low dose inhaled fluticasone + SABA	
Asthma: High dose inhaled fluticasone + SABA	
Asthma: Theophylline + High dose inhaled fluticasone + SABA	
Asthma: Oral Prednisolone + Theophylline + High dose inhaled fluticasone + SABA	
COPD: Smoking cessation	
COPD: Inhaled salbutamol	
COPD: Low-dose oral theophylline	
COPD: Ipratropium inhaler	
COPD: exacerbation treatment with antibiotics	
COPD: exacerbation treatment with oral prednisolone	
COPD: exacerbation treatment with oxygen	
Emergency care	
Average annual emergency care needs	N/A
Child Health	
General	
General Health (Children)	MOH Statistical Yearbook 2019[15]
Zinc supplementation	Assumption derived from UHC Service Coverage Index (WHO)[2]
Diarrhea management	
ORS	Assumption derived from UHC Service Coverage Index (WHO)[2]
Zinc (diarrhea treatment)	
Antibiotics for treatment of dysentery	
Treatment of severe diarrhea	
Pneumonia	
Pneumonia treatment (children, mild cases)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Treatment of severe pneumonia	
Nutrition	
Women of reproductive age and adolescent girls	
Intermittent iron-folic acid supplementation	Estimate from Alreshidi et al. (2018)[18]
Pregnant and lactating women	
Daily iron and folic acid supplementation (pregnant women)	Estimate from Al-Duraibi and Am-Mutawa (2020)[19]
Intermittent iron and folic acid supplementation (non-anaemic pregnant women)	

Vitamin A supplementation in pregnant women	Estimate from Azzeh and Refaat (2020)[20]
Iodine supplementation in pregnant women	
Adults	
Care for adults with low BMI	Assumption derived from Bahrain
Children	
Breastfeeding counselling and support	Assumption derived from Service Coverage Sub-Index on MNCH (WHO)[2]
Complementary feeding counselling and support	
Management of moderate acute malnutrition (children)	Assumption derived from UHC Service Coverage Index (WHO)[2]
Mental Health	
Anxiety disorders	
Basic psychosocial treatment for anxiety disorders (mild cases)	Assumption: 1.0%
Basic psychosocial treatment and anti-depressant medication for anxiety disorders (moderate-severe cases)	
Depression	
Basic psychosocial treatment for mild depression	Assumption: 1.0%
Basic psychosocial treatment and anti-depressant medication of first episode moderate-severe cases	
Psychosocial care for peri-natal depression	
Psychosis	
Basic psychosocial support and anti-psychotic medication	Assumption: 1.0%
Bipolar disorder	
Basic psychosocial treatment, advice, and follow-up for bipolar disorder, plus mood-stabilizing medication	Assumption: 1.0%
Epilepsy	
Basic psychosocial support, advice, and follow-up, plus anti-epileptic medication	Assumption: 1.0%
Developmental disorders	
Basic psychosocial treatment, advice, and follow-up for developmental disorders	Assumption: 1.0%
Conduct disorders	
Basic psychosocial treatment, advice, and follow-up for behavioural disorders	Assumption: 1.0%
Dementia	
Assessment, diagnosis, advice, and follow-up for dementia	Assumption: 1.0%
Alcohol use/dependence	
Identification and assessment of new cases of alcohol use/dependence	Assumption: 1.0%
Brief interventions and follow-up for alcohol use/dependence	
Drug use/dependence	
Identification and assessment of new cases of drug use/dependence	Assumption: 1.0%
Brief interventions and follow-up for drug use/dependence	
Self-harm/suicide	
Assess and care for person with self-harm	Assumption: 1.0%
Maternal Newborn and Reproductive Health	
Family planning	

Pill - Standard daily regimen	KSA World Health Survey[16]
IUD - Copper-T 380-A IUD (10 years)	
Withdrawal	
Pregnancy care - ANC	
Tetanus toxoid (pregnant women)	Estimate from KSA World Health Survey[16]
Basic ANC	
Pregnancy care - Treatment of pregnancy complications	
Hypertensive disorder case management	Assumption: 100%
Childbirth care - Facility births	
Pre-referral management of labour complications	Assumption: 100%
Postpartum care - Other	
Treatment of postpartum haemorrhage	Assumption: 100%
Other sexual and reproductive health	
Treatment of urinary tract infection (UTI)	Assumption derived from UHC Service Coverage Sub-Index on MNCH (WHO)[2]
Treatment of syphilis	
Treatment of gonorrhoea	
Treatment of chlamydia	
Treatment of trichomoniasis	
Treatment of PID (Pelvic Inflammatory Disease)	
General Practice	
General Practice	MOH Statistical Yearbook 2019[15]
Oral Care	
Dental cleaning and preventive care	MOH Statistical Yearbook 2019[15]

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CHEERS checklist—Items to include when reporting economic evaluations of health interventions

Section/item	Item No	Recommendation	Reported on page No/line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	P.1 / L.1-2
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	P.2 / L.1-28
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study.	P.3 / L.1-28
		Present the study question and its relevance for health policy or practice decisions.	P.4-5 / L.30-2
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	NR
Settings and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	NR
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	P.6 / L.3-14
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	P.6 / L.6-8 & Table S1
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	P.4 / L.36
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	NR
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	NR
Measurement of effectiveness	11a	Single study-based estimates: Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	NR
	11b	Synthesis-based estimates: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	NR
Measurement and valuation of 12 preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	NR
Estimating resources and costs	13a	Single study-based economic evaluation: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	P.6-7 / L.34-31

	13b	Model-based economic evaluation: Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	NR
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	NR
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	NR
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	Table S2-S8
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	NR
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	Table S1-S8
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	NR
Characterising uncertainty	20a	Single study-based economic evaluation: Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	NR
	20b	Model-based economic evaluation: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	NR
Characterising heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	NR
Discussion			
Study findings, limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	P.13-17 / L.1-3

Other			
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	P.20 / L.14-16
Conflict of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	P.20 / L.10-12