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Unnecessary hospitalisations and polypharmacy practices in Tajikistan: a health system evaluation for strengthening primary healthcare

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ABSTRACT

Background Children and pregnant women require multiple contacts with the healthcare system. While most conditions can be managed by primary healthcare (PHC) providers, hospitalisations are common. This health system evaluation in Tajikistan quantifies unnecessary and unnecessarily prolonged hospitalisations and assesses antibiotic and polypharmacy practices.

Methods Data were retrospectively collected from randomly selected medical records from 15 hospitals. Inclusion criteria were children 2–59 months of age with a primary diagnosis of acute respiratory infection or diarrhoea, or pregnant women with threatened preterm labour, threatened miscarriages, premature rupture of membranes or mild pre-eclampsia, hospitalised between January and September 2021.

Results Among 440 children and 422 pregnant women, unnecessary hospitalisations accounted for 40.5% and 69.2% of hospitalisations, respectively, ranging from 0% to 92.7% across the hospitals.

Among necessary hospitalisations, 63.0% and 39.2% were unnecessarily prolonged in children and women, respectively.

Prior to admission, 36.8% of children had received antibiotics, in which more than half intramuscularly. During hospitalisation, 92.5% of children and 28.9% of women received antibiotics. Children and women received an average of 5 and 6.5 drugs, respectively; most were not indicated or with no evidence of benefits.

Conclusions The methodology is applicable across all health systems and can provide important insights on health service use and resource waste. Findings of this assessment in Tajikistan have led to evidence-based decisions and actions from stakeholders and policy makers with the goal of strengthening PHC and improving the management of common diseases in children and pregnant women.

BACKGROUND

Children under 5 years of age often get sick, and pregnant women require several antenatal care visits and may need medical care for pregnancy-related conditions. Most of these diseases and conditions can be entirely and safely managed at the primary healthcare (PHC) level. The global strategy of Integrated Management of Childhood Illness (IMCI) and the Integrated Management of Pregnancy and Childbirth (IMPAC) provide standards

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Unnecessary hospitalisations and misuse of antibiotics cause harm and take a financial toll on users and health systems.
- ⇒ Primary healthcare remains underused despite being key for achieving Universal Health Coverage.

WHAT THIS STUDY ADDS

- ⇒ This health system evaluation in Tajikistan quantified the proportion of children and pregnant women hospitalised unnecessarily and for too long.
- ⇒ It quantified misuse of antibiotics, including among children with diarrhoea, and the prescription of other medications with no evidence of benefits.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Unnecessary and unnecessarily prolonged hospitalisations are a proxy for the underperformance of primary healthcare.
- ⇒ The methodology can be implemented in other settings. Repeated at different points in time, it allows monitoring of health system performance.
- ⇒ The Ministry of Health has committed to enquire the root causes of unnecessary hospitalisations and polypharmacy and to engage in a participatory policy dialogue.

for the management of children and women at the PHC level and for the identification of those who need timely referral for hospital care.^{1,2}

Observations from completed WHO assessment visits to countries in the WHO European Region showed that children with common conditions such as pneumonia or diarrhoea were often admitted to hospitals for treatment, but this was not quantified.³ Such conditions, however, could often be managed following the IMCI approach at the PHC level rather than in an inpatient context. Hospitalisation can lead to unnecessary psychological, emotional and physical disturbances and contribute to disruption of education, increased nosocomial infections and a larger financial burden incurred both by patients and health facilities.^{4–10} In

addition, patients should be hospitalised only for the time that is strictly required.^{11 12}

The Republic of Tajikistan is a landlocked country in Central Asia with 9 million inhabitants, of which a third are children aged 0–14 years.^{13–15} Respiratory infections and diarrhoeal diseases remain the most common causes of childhood hospitalisations and among the top causes of death.^{16 17} The fertility rate in the country (3.1 children per woman in 2021) is higher than globally and the other countries in Central Asia.^{17 18} Despite PHC being key for achieving Universal Health Coverage, especially in a mountainous country with added difficulties for transportation, PHC facilities remain largely underused.¹⁹ Data on unnecessary hospitalisation of children and pregnant women, that is, who could have been managed safely and entirely in a PHC setting, would provide a sound basis for discussion on the need to strengthen PHC and to improve the efficiency of health service delivery.

Previous observations in Tajikistan suggest that treatment of common childhood conditions often comprises multiple unnecessary and invasive drugs.¹⁹ Assessing the prescription of antimicrobials and other drugs in hospitalised children and women will help understanding the magnitude of the problem and allow targeted solutions.

This health system evaluation was conducted in Tajikistan with the aim to quantify unnecessary and unnecessarily prolonged hospitalisations in children and pregnant women and to quantify antibiotic use and polypharmacy in hospitalised children and pregnant women.

METHODS

Study design

We conducted this health system evaluation in September–October 2021 in 15 public hospitals (online supplemental figure S1). WHO consultants and a technical working group established by the Ministry of Health and Social Protection of Population (MoHSPP), comprising obstetricians and paediatricians, travelled to the hospitals for data collection.

Inclusion criteria

We reviewed medical records of children 2–59 months of age hospitalised with a primary diagnosis of acute respiratory infection or intestinal infection (diarrhoea) and of pregnant women up to 37 gestation weeks hospitalised with a primary diagnosis of threatened preterm labour, threatened miscarriages, premature rupture of membranes or mild pre-eclampsia (table 1). These primary diagnoses are the most common causes of hospitalisations for these population groups in Tajikistan.¹⁶

Standard of care and determination of necessary or unnecessary hospitalisations

The reference for standard of care for children was the *WHO pocket book of Hospital care for children* as it is broadly used in Tajikistan and has already been used in similar assessments.^{20 21}

For pregnant women, we used national protocols,^{22–27} endorsed by experts including from WHO and aligned with the IMPAC and the content of the effective perinatal care course that had been implemented in the country.²

For the classification of hospitalisation into necessary or unnecessary, we compared the clinical characteristics on admission from medical records against the standard of care (online supplemental tables S1 and S2). We classified hospitalisation as *necessary* if at least one criterion for hospitalisation was found, *unnecessary* if all the hospitalisation criteria were documented

Table 1 Inclusion criteria for evaluation of unnecessary hospitalisations

Population group	Inclusion criteria
Children	<ul style="list-style-type: none"> ▶ Hospitalised (admitted in the ward staying overnight). ▶ 2–59 months of age. ▶ Any of the following primary diagnosis (ICD-10³⁹ code): <ul style="list-style-type: none"> – Upper respiratory infection (J00–J06). – Pneumonia (J12–J18). – Acute bronchitis (J20). – Acute bronchiolitis (J21). – Other acute lower respiratory tract infection (J22). – Intestinal infection (diarrhoea) (A00–A09).
Pregnant women	<ul style="list-style-type: none"> ▶ Hospitalised (admitted in the ward staying overnight). ▶ Confirmed pregnancy up to 37 gestation weeks. ▶ Any of the following primary diagnoses (ICD-10³⁹ code): <ul style="list-style-type: none"> – Threatened preterm labour up to 37 gestation weeks (O60).* – Threatened miscarriages up to 22 gestation weeks (O20–O20.9). – Premature rupture of membranes (O42.2). – Mild preeclampsia (O14.0).
<p>*Pregnant women with starting preterm labour with imminent preterm delivery are managed in the delivery department and were excluded from this evaluation. ICD-10, International Statistical Classification of Diseases and Related Health Problems, 10th revision.</p>	

in the medical records and the child or woman did not meet any or *unclear* if information was missing. We classified hospitalisation as *unnecessarily prolonged* when the patient presented all discharge criteria for longer than 24 hours prior to discharge with no new hospitalisation criteria. All unnecessary hospitalisations were considered unnecessarily prolonged.

Participant selection

In each hospital, the evaluation team randomly selected medical records (1 out of every 10 from the piles of medical records) from children and women hospitalised in January–September 2021, until obtaining 40 records for children and 40 for women. The number of 40 was chosen for feasibility and based on previous similar work.²¹

Data collection, management and analysis

Data were extracted from medical records and recorded into an excel file together with the statement of necessary or unnecessary hospitalisation and prolonged hospitalisation. We analysed data with Microsoft Excel Program and Stata V.16.0.²⁸ Comparison of proportions was performed using the χ^2 test or Fisher's exact test.

National ethical clearance

Clearance from the MoHSPP was obtained in the context of the project for improving quality of hospital care, with Prikaz No 708 from 12 August 2021.

RESULTS

Baseline characteristics

For children, 440 medical records met our inclusion criteria (online supplemental figure S2); their baseline characteristics are presented in table 2. The average age was 15.8 months (median 13, IQR 7–20.5). Overall, 205/440 (46.6%) children were referred from PHC or other hospitals, and 34/440 (7.7%) children were admitted at night (22:00–06:00). Children hospitalised with a primary diagnosis of a respiratory infection were classified in the medical records as pneumonia (94/440; 21.4%), acute bronchitis

Table 2 Baseline characteristics of children and pregnant women

	Children (n=440)	Pregnant women (n=422)
Age, median	13 months	24 years
Referral from PHC or other hospitals	205 (46.6%)*	273 (64.7%)
Night admission (22:00–06:00)	34 (7.7%)	33 (7.8%)
Primary diagnosis	Acute gastroenteritis: 142 (32.3%) Pneumonia: 94 (21.4%) Acute bronchitis or bronchiolitis: 86 (19.5%) Acute respiratory infection: 118 (26.8%)	Threatened preterm labour: 222 (52.6%) Threatened miscarriage: 170 (40.3%) Mild pre-eclampsia: 17 (4.0%) Premature rupture of membranes: 13 (3.1%)
Other diagnoses present at admission or during hospitalisation	Anaemia: 178 (40.5%) "Neurotoxicosis"†: 52 (11.8%) Malnutrition: 37 (8.4%) Perinatal encephalopathy: 24 (5.5%) Rickets: 11 (2.5%) Seizure: 10 (2.3%) Sepsis: 4 (0.9%) Cerebral palsy: 3 (0.7%)	Anaemia: 202 (47.9%) Chronic pyelonephritis: 92 (21.8%) Goitre: 12 (2.8%) Underweight: 9 (2.1%)

*Data collection on referral was missed for 30 children.

†'Neurotoxicosis' is not recognised as a diagnosis according to the ICD-10 classification. PHC, primary healthcare.

or bronchiolitis (86/440; 19.5%) and acute respiratory infection (118/440; 26.8%). The remaining 142 children (32.3%) had a primary diagnosis of diarrhoea or acute gastroenteritis, including one child with ascariasis and one child with dysentery and confirmed amoebiasis. Other diagnoses were common; the most commonly documented were anaemia (178/440; 40.5%) and 'neurotoxicosis' (52/440; 11.8%) (table 2).

For pregnant women, 422 medical records met our inclusion criteria (online supplemental figure S3; table 2). The median age was 24 years. Two hundred and seventy-three of 422 (64.7%) women were referred from another health centre and 33/422 (7.8%) were admitted at night. Women were hospitalised due to threatened preterm labour (222/422; 52.6%), threatened miscarriage (170/422; 40.3%), mild pre-eclampsia (17/422; 4.0%) or

premature rupture of membranes (13/422; 3.1%). Among other diagnoses, 202/422 (47.9%) pregnant women had anaemia and 92/422 (21.8%) had chronic pyelonephritis.

Unnecessary hospitalisations

Overall, 178/440 (40.5%) children and 292/422 (69.2%) pregnant women were unnecessarily hospitalised. It was unclear whether hospitalisation was necessary in eight (1.8%) children (missing information in the medical records). The proportion of unnecessary hospitalisations varied between diagnoses both in children and women (7.7%–84.2%) (figure 1) and between hospitals (0%–71.8% for children and 31.4%–97.2% for women) (figure 2) but was similar between age groups (infants

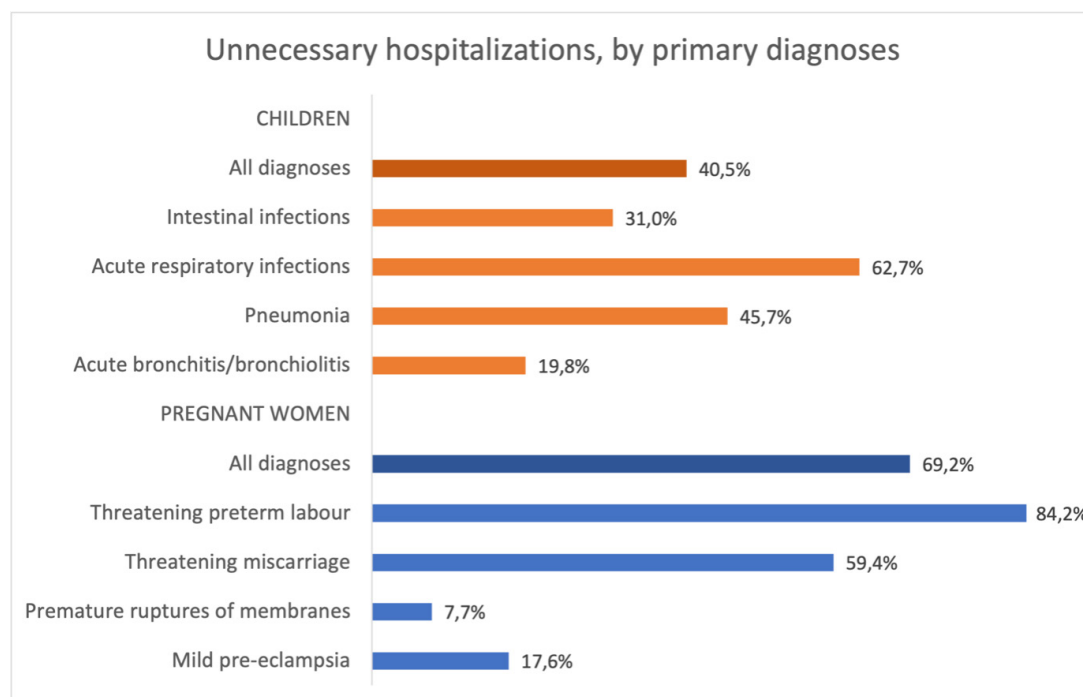


Figure 1 Proportion of unnecessary hospitalisations in children and pregnant women, among all diagnoses and by primary diagnoses.

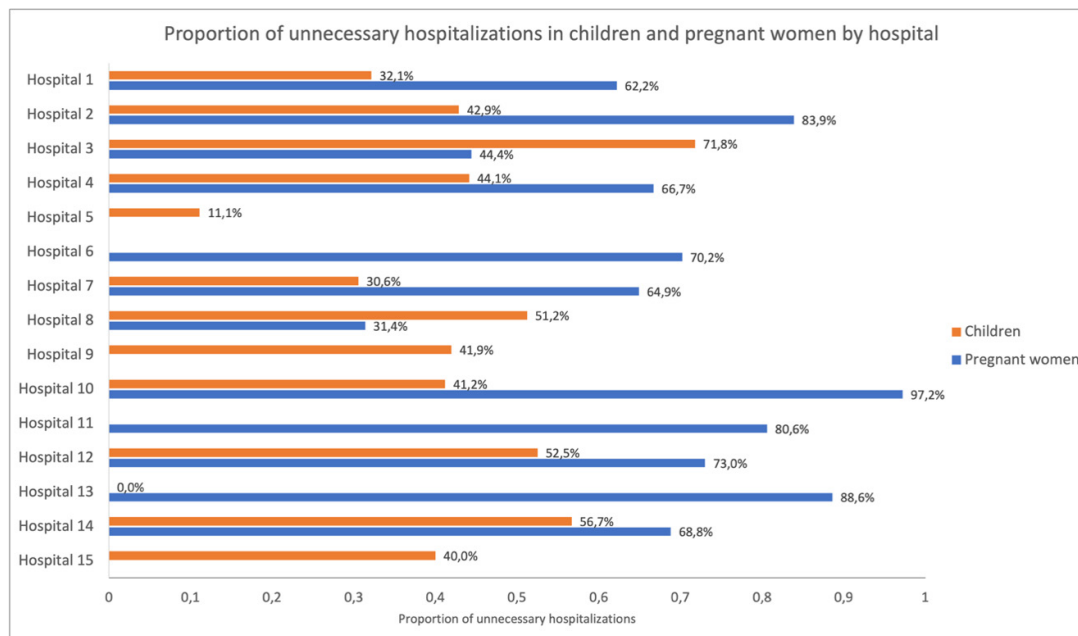


Figure 2 Proportion of unnecessary hospitalisations in children and pregnant women, by hospital.

2–11 months vs children 12–59 months), time of admission (day vs night), referral (referred from another health facility vs came by themselves) and between regional and city/district hospitals (online supplemental figures S4 and S5).

Unnecessarily prolonged hospitalisations

The median duration of hospitalisation was 8 days (IQR 6–10) in children and 7 days (IQR 4–8) in women. The duration of hospitalisation did not differ between necessary and unnecessary hospitalisations. Differences by diagnoses and by hospitals are shown in online supplemental figures S6–S8.

Among necessary hospitalisations, 160/254 (63.0%) were unnecessarily prolonged in children (unclear for seven children)

and 51/130 (39.2%) in women. The proportion of unnecessarily prolonged hospitalisations did not differ by type of diagnoses in children but ranged from 14.3% in women with mild pre-eclampsia to 54.3% in those with threatened preterm labour (figure 3) and varied by hospital (online supplemental figure S9).

Unnecessarily prolonged hospitalisations were more common among children of 12–59 months of age (69.3%) compared with infants (55.6%), although the difference was not statistically significant. Unnecessarily prolonged hospitalisations were similar among type of hospitals and referral status (online supplemental figure S10).

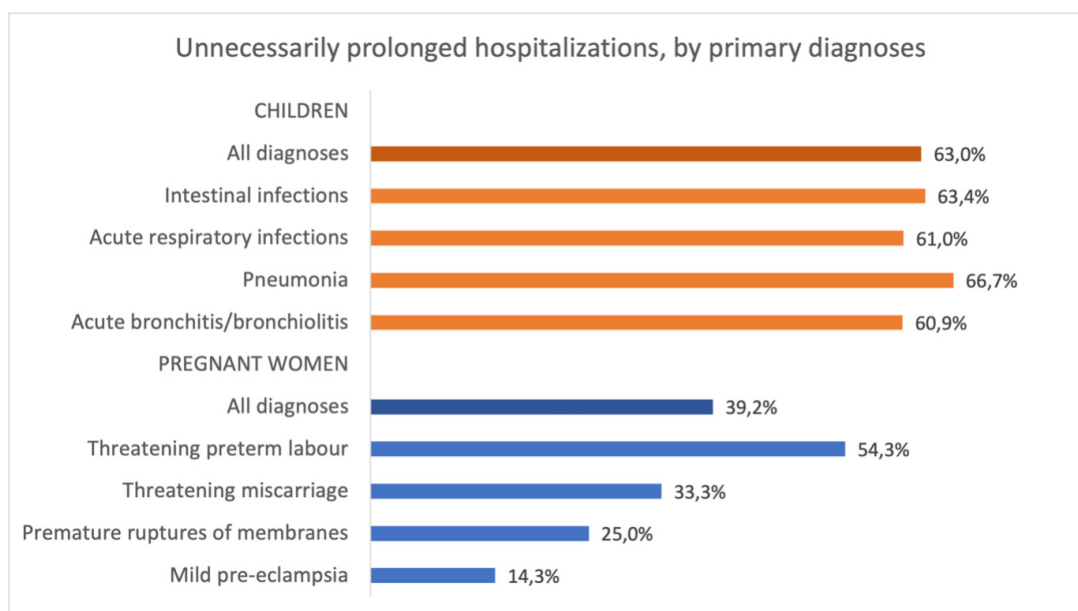


Figure 3 Proportion of unnecessarily prolonged hospitalisations among necessary hospitalisations in children and pregnant women, among all diagnoses and by primary diagnoses.

Antimicrobials

Prior to admission, 110/299 (36.8%) children received at least one antibiotic, corresponding to 77/194 (39.7%) children with a respiratory infection and 33/105 (31.4%) children with diarrhoea. These drugs were given intramuscularly in 64/110 (58.2%) children.

During hospitalisation, 407/440 (92.5%) children received at least one antimicrobial and 115/440 (26.1%) received at least two. Antibiotics were prescribed to 122/142 (85.9%) children with diarrhoea. Overall, the antibiotics most prescribed were ampicillin (received by 135/440 (30.7%) children), ceftriaxone (98/440; 22.3%), cefotaxime (45/440; 10.2%), gentamicin (34/440; 7.7%) and amikacin (29/440; 6.6%).

Overall, 122/422 (28.9%) women were prescribed antibiotics during hospitalisation, mostly ampicillin, ceftriaxone or metronidazole. The reason for prescription was frequently due to secondary diagnoses such as chronic pyelonephritis or respiratory infections, which were in most cases not confirmed clinically or by laboratory tests on admission but based on diagnoses reported in the referral paper and therefore likely to be unjustified.

Polypharmacy

Hospitalised children and women received an average of 5 and 6.5 drugs, respectively. Drugs in children included oral rehydration salts, intravenous fluids and short-acting bronchodilators. Medications were often not indicated or with no evidence of benefits, such as antihistamines, probiotics, spasmolytics, mucolytics, interferon alfa-2b (Viferon), affinity-purified antibodies to human interferon gamma (Anaferon) and vitamin complex. Some children received intravenous insulin together with intravenous glucose solution.

Women were also commonly prescribed medications when they were not indicated or with no evidence of benefits, such as valerian, papaverine suppository, different types of vitamins, vitamin C and herbal tea for kidney diseases.

DISCUSSION

Unnecessary hospitalisations were common, accounting for 40.5% and 69.2% of hospitalisations in children and pregnant women, respectively. Among necessary hospitalisations, children and women were commonly kept too long when they could have safely been discharged. The misuse of antibiotics was considerable, which is of particular concern for the potential direct harm for the patients and for accelerating antimicrobial resistance, a global public health challenge.²⁹ While antibiotics might well be indicated in children with severe pneumonia, the choice of antibiotics was not conformed to guidelines in a considerable proportion of cases. The situation is more worrying in children with diarrhoea, for which antibiotics are not indicated (except in case of dysentery) and can cause harm. Despite only one child with dysentery, 85.9% of children hospitalised with diarrhoea received antibiotics. In addition, children and women were commonly prescribed medication with no evidence of benefits.

Identifying contributing factors and understanding the rationale behind such practices (unnecessary hospitalisations and unnecessary medications) are primordial to allow targeted solutions. While quality education and training doctors on hospitalisation criteria and management of common diseases following standards of care are surely needed, other actions are also needed for improving quality of care.

National regulations that mandate hospitalisations probably contribute to unnecessary hospitalisations; for example,

a referred patient coming at night needs to be hospitalised. In some cases, it is unclear whether practices are mandated by law or are the consequence of what healthcare worker believed to be regulated by law.

Allocation of public resources to the health sector is limited in Tajikistan, which is reflected in low salaries of health workers and high out-of-pocket payments for healthcare at all levels.³⁰ Spending on medicines accounts for 37% of out-of-pocket payments.³¹ Reliance on informal payments to supplement salaries, and salaries and workforce directly linked to hospital bed occupancy, are likely to lead to non-evidence-based treatment and unnecessary hospitalisations. In addition, the common perception of patients and caregivers not feeling well taken care of if no medication is prescribed is likely to worsen the prescription of unnecessary drugs, despite the considerable cost incurred. Seven days' treatment with four or five of the commonly used drugs was estimated, based on observations and data collected during this assessment, to a cost of 320 Tajikistani somoni (25 euros), which corresponds to around 20% of an average monthly salary. Investigations such as laboratory testing and parenteral medications are also expected by many patients to feel well taken care of. Awaiting investigations results and completing parenteral antibiotic courses (while sometimes not required or could have been given orally at home) could partly explain some of the prolonged hospitalisations. In addition, the Tajik population seems to consider hospital care superior to the care they could receive at PHC level. This surely lowers the threshold for admitting people to hospitals, leading to increased unnecessary hospitalisations. The PHC approach is key to achieving the goal of Health for All, which is physical, mental and social well-being for everyone in the community.³²⁻³⁴ Understanding community and health workers practices, perceptions and behaviours on healthcare and hospitalisation is key to success towards PHC and high-quality health services.³⁴

This health system evaluation identified areas of concerns where qualitative research is warranted, including understanding the root causes of unnecessary hospitalisations.³⁵ Based on these findings, the MoHSPP has committed to reviewing rules and regulations associated with hospitalisations, reviewing funding and financing systems for incentives for unnecessary hospitalisation, strengthening PHC and raising awareness on the harm of unnecessary hospitalisation and on the ineffectiveness of antibiotics for viral infections.

Another key achievement of this assessment is the identification of reliable indicators for monitoring progress. This health system evaluation in Tajikistan allowed to quantify children in hospitals that could have benefitted from PHC services. To the best of our knowledge, this kind of system evaluation has not previously been implemented elsewhere. The recognition of the need for reducing hospitalisations, however, is not new. A decade ago, researchers developed a tool to monitor potentially avoidable hospitalisations (those which might be avoided by government policies ensuring socioeconomic resources, access to timely, appropriate and affordable PHC, and the implementation of health promotion and disease prevention strategies) in children.^{36,37} By contrast with the potentially avoidable hospitalisations approach, which integrates many factors and is based on estimates, the methodology we used is easy to implement in all settings. Repeated at different points in time, the quantification of two specific and objective indicators (unnecessary hospitalisations and unnecessarily prolonged hospitalisations) allows monitoring the effectiveness of interventions for improving quality of hospital care. Such indicators may well have their role in measuring effectiveness, safety and indirectly access, within the

health system performance assessment framework for universal health coverage.³⁸

The limitations of this evaluation include the retrospective data collection from medical records. Information not recorded in the medical charts may lead to an overestimation of unnecessary and unnecessarily prolonged hospitalisations. For example hospitalisation of women or children due to social circumstances that might not be documented.

The strengths of this evaluation are multiple. Data were collected in 15 hospitals with different settings throughout Tajikistan (Soghd oblast, the Rayon Republican Subordinations and Dushanbe), making the findings most likely applicable to the whole country. Methodology was transparent, systematic and rigorous, making the evaluation reproducible for data comparison and tracking progress (monitoring) by following the same methodology, and for replication of this health system evaluation to other settings. This assessment focused on the most common diagnoses in hospitalised children and pregnant women in Tajikistan. The use of these findings for strengthening the management of these common diagnoses in PHC are likely to have a considerable impact in the overall quality of care for children and pregnant women.

CONCLUSIONS

Findings of this assessment in Tajikistan have led to evidence-based decisions and actions from stakeholders and policy makers with the goal of strengthening PHC and improving the management of common diseases in children and pregnant women.

Unnecessary hospitalisations and unnecessarily prolonged hospitalisations constitute two objective indicators for evaluating and monitoring progress in health system performance to ensure universal health coverage.

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Unnecessary hospitalizations and polypharmacy practices in Tajikistan: a health system evaluation for strengthening primary health care

Supplementary material

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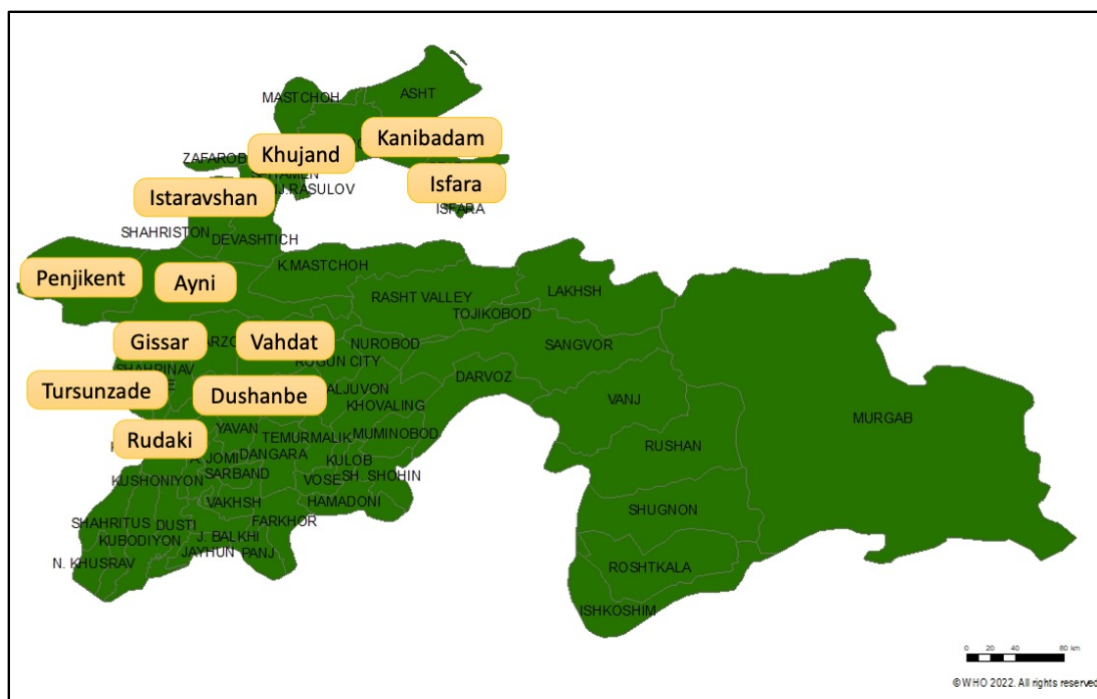


Figure S1. Cities where data were collected from 15 hospitals in Tajikistan.

These hospitals were selected by the Ministry of Health and Social Protection of Population and WHO for their involvement in the ongoing WHO project for improving the quality of hospital care, based on the low support received by development partners as compared to other regions in the country and their high-density catchment area.

Regional hospitals

1. Child Infection Hospital, Dushanbe (paediatric hospital, data collection for children only)
2. Istiqlol Hospital, Dushanbe (paediatric hospital, data collection for children only)
3. Republican Hospital Karabolo, Dushanbe
4. Khujand oblast child clinical hospital (paediatric hospital, data collection for children only)

City/district hospitals

5. Maternity #2, Dushanbe (maternity hospital, data collection for pregnant women only)

Rayon Republican Subordinations

6. Gissar Central District hospital
7. Rudaki Central District hospital
8. Tursunzade Central District hospital
9. Vahdat Central District hospital

Soghd Oblast

10. Ayni Central District hospital
11. Isfara Central District hospital
12. Istaravshan Central District hospital
13. Kanibadam Central District hospital
14. Khujand city maternity hospital (maternity hospital, data collection for pregnant women only)
15. Penjikent Central District hospital

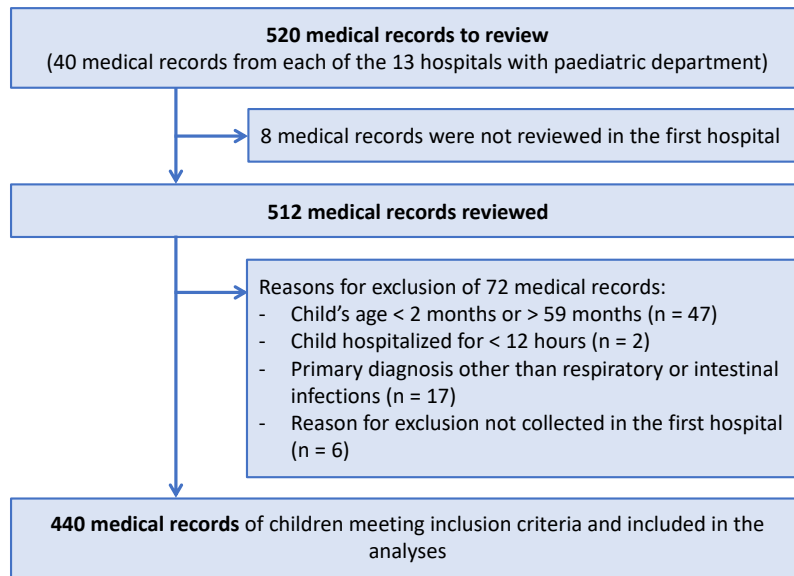


Figure S2. Flow diagram illustrating selection of medical records for children.

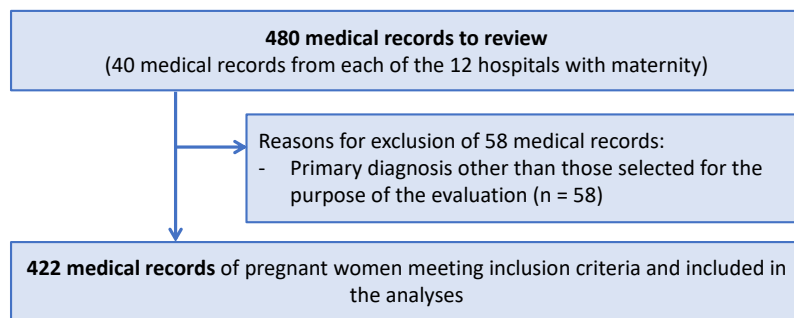


Figure S3. Flow diagram illustrating selection of medical records for pregnant women.

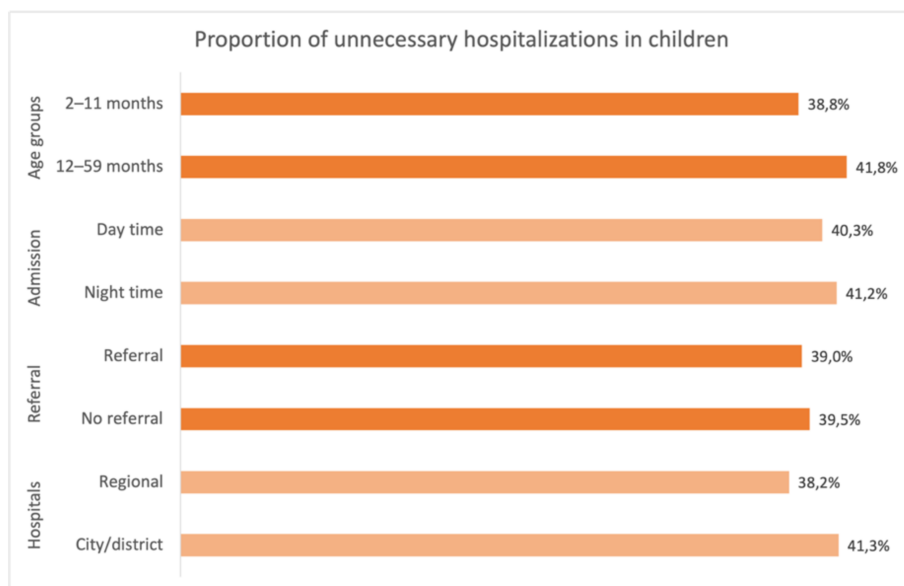


Figure S4. Proportion of unnecessary hospitalizations in children by age groups, time of admission, referral and hospital level.

Note: Comparison of proportions was performed using the chi-square test. For each group (age, admission, referral, hospitals), the difference of proportions was not statistically significant ($p > 0.05$). Day time was defined as 6 am–10 pm.

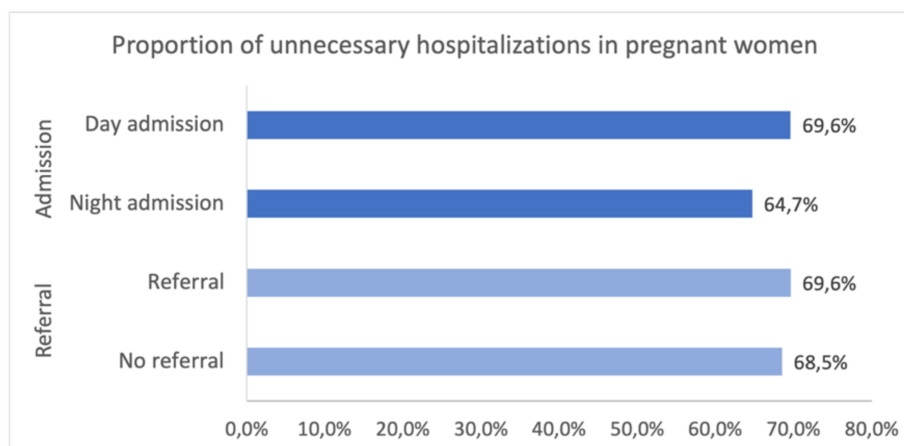


Figure S5. Proportion of unnecessary hospitalizations in pregnant women by time of admission and referral.

Note: Comparison of proportions was performed using the chi-square test. For each group (admission, referral), the difference of proportions was not statistically significant ($p > 0.05$). Day time was defined as 6 am–10 pm.

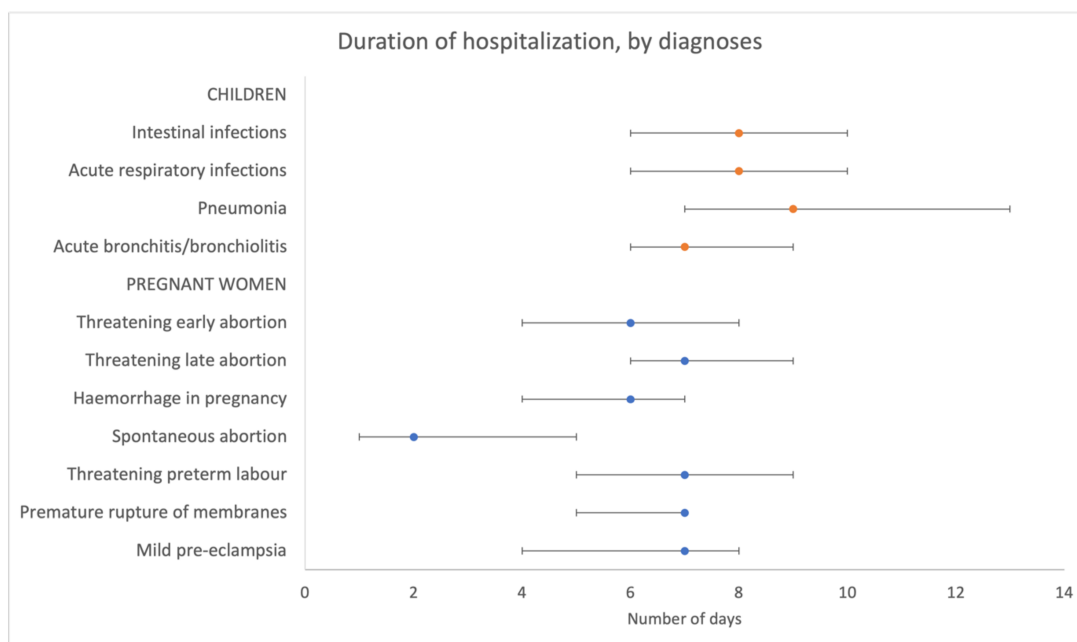


Figure S6. Duration of hospitalization in children and pregnant women by primary diagnoses.

The orange (children) and blue (pregnant women) dots show the median duration of hospitalization, in days, and the horizontal black line the interquartile range of duration of hospitalization, for each primary diagnosis. The primary diagnosis at admission of threatened miscarriage was disaggregated by diagnosis at discharge, as diagnoses at discharge are those directly related with duration of hospitalization: threatened early abortion (up to 12 weeks of gestation), threatened late abortion (13–22 weeks of gestation), haemorrhage in pregnancy, and spontaneous abortion.

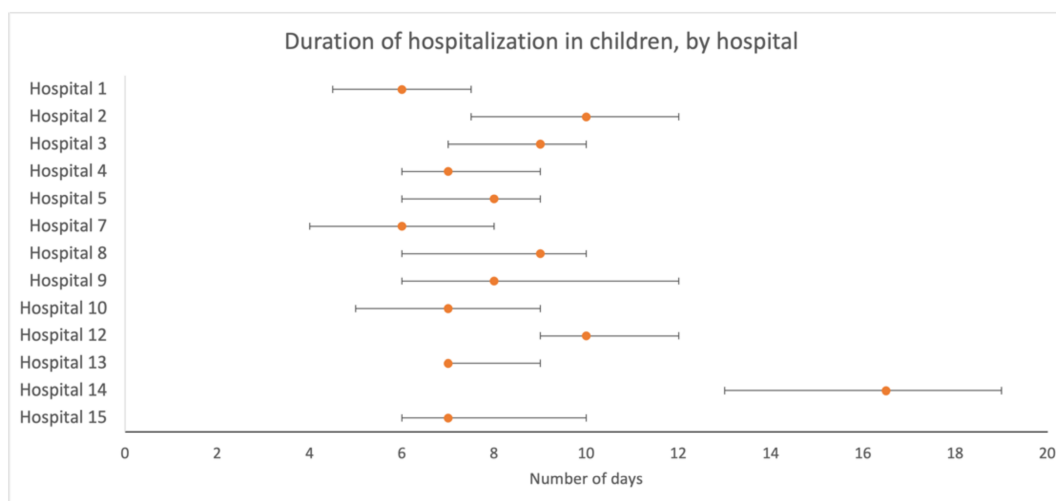


Figure S7. Duration of hospitalization by hospital in children.

The orange dots show the median duration of hospitalization, in days, and the horizontal black line the interquartile range of duration of hospitalization, for each hospital.

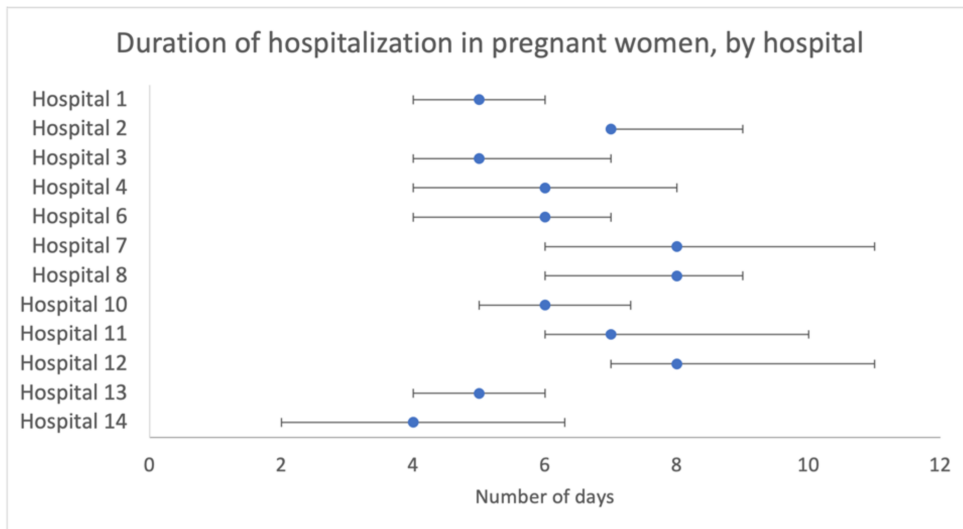


Figure S8. Duration of hospitalization by hospital in pregnant women.

The blue dots show the median duration of hospitalization, in days, and the horizontal black line the interquartile range of duration of hospitalization, for each hospital.

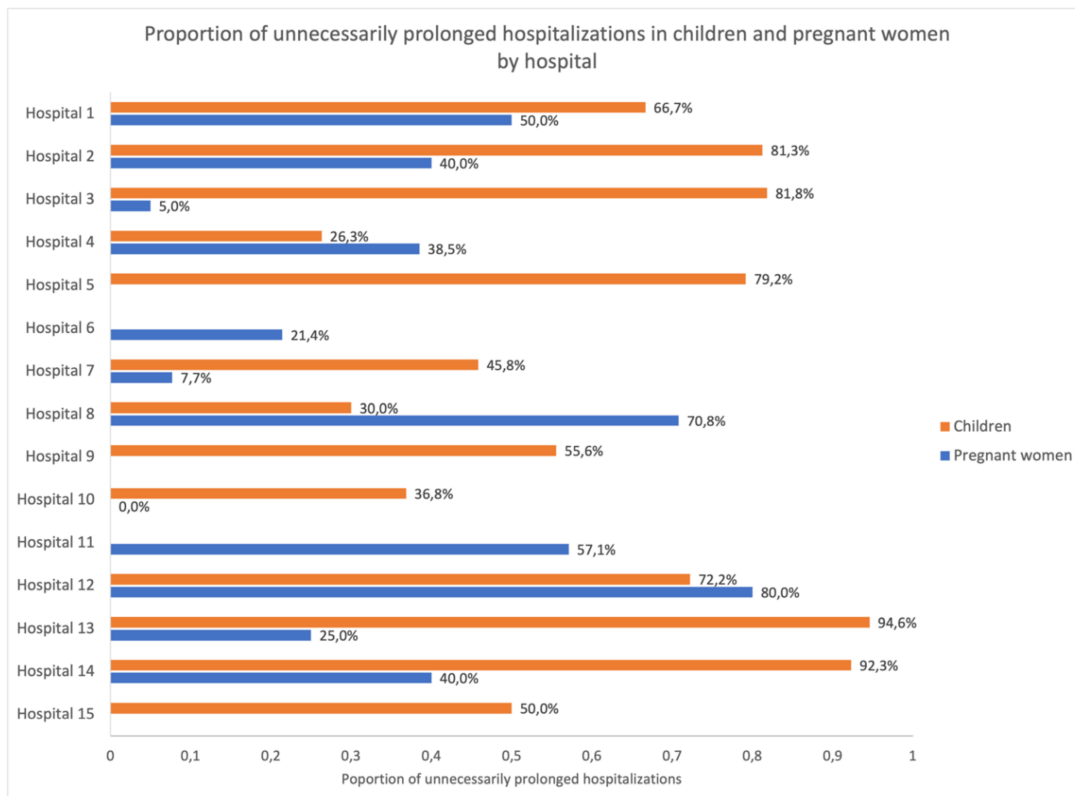


Figure S9. Proportion of unnecessarily prolonged hospitalizations among necessary hospitalizations in children and pregnant women, by hospital.

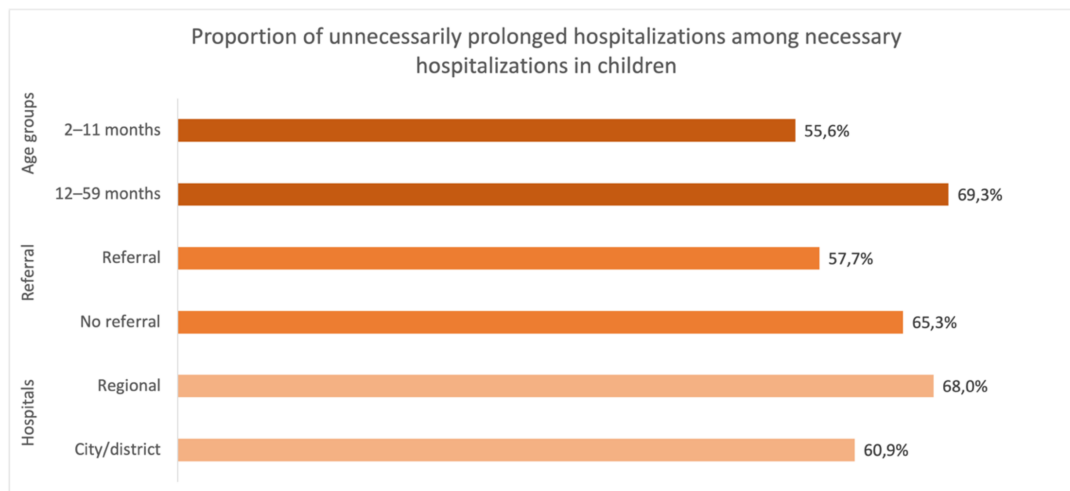


Figure S10. Proportion of unnecessarily prolonged hospitalizations among necessary hospitalizations in children, by age, referral and hospital level.

Note: Comparison of proportions was performed using the chi-square test or Fisher exact test. For each group (age, referral, hospitals), the difference of proportions was not statistically significant ($p > 0.05$).

Table S1. Standards of care for assessment of unnecessary and unnecessarily prolonged hospitalizations in children

Disease, condition (ICD-10 code ¹)	Hospitalization criteria ²	Discharge criteria ²
FOR ALL	The presentation of any general danger sign entails a hospitalization criterion by itself: <ul style="list-style-type: none"> • inability to drink or breastfeed, • vomiting everything, • history of convulsions during the current illness, • lethargy, unconsciousness or convulsions. 	A decision on when to discharge should be made on an individual basis, taking into consideration factors such as: <ul style="list-style-type: none"> • the family's home circumstances and how much support is available to care for the child • the staff's judgement of the likelihood that the treatment course will be completed at home or that the family will return immediately to hospital if the child's condition worsens.
Upper respiratory tract infection including common cold and croup (J00–J06)	Severe pneumonia (see "pneumonia" below) Severe croup, defined by any of the following: <ul style="list-style-type: none"> • Stridor even when the child is at rest • Rapid breathing and low chest indrawing • Oxygen saturation <90% or central cyanosis 	<ul style="list-style-type: none"> • Respiratory distress resolved • No hypoxaemia (SpO₂>90%) on room air • No apnoea • No stridor • Alert • Afebrile • No severe dehydration • Feeding/eating well • Not vomiting everything • Able to take oral medication (if needed)
Pneumonia (J12–J18)	Severe pneumonia, defined by any of the following: <ul style="list-style-type: none"> • Oxygen saturation <90% or central cyanosis • Severe respiratory distress (grunting, very severe chest indrawing) Pneumonia not improving after three days (of oral antibiotics)	
Acute bronchitis (J20) Acute bronchiolitis (J21) Unspecified acute lower respiratory tract infection (J22)	<ul style="list-style-type: none"> • Oxygen saturation <90% or central cyanosis • Apnoea or history of apnoea • Gaspings and grunting (especially in young infants) • Not improving 15 minutes after administration of rapid-acting bronchodilator (e.g. salbutamol) <ul style="list-style-type: none"> - Signs of severe pneumonia (see above) - Fast breathing: ≥ 50 breaths/minute in 2–11 months, ≥ 40 breaths/minute in 1–5 years 	
Diarrhoea, acute gastroenteritis, intestinal infectious diseases (A00–A09)	Severe dehydration, defined as ≥ 2 of the following signs: <ul style="list-style-type: none"> • lethargy or unconsciousness • sunken eyes • unable to drink or drinks poorly • skin pinch goes back very slowly (≥ 2 sec) or "reduced turgor" Severe persistent diarrhoea: <ul style="list-style-type: none"> • diarrhoea lasting ≥ 14 days • with signs of dehydration: see severe dehydration signs above, or ≥ 2 of the following signs: restlessness, irritability; sunken eyes; drinks eagerly, thirsty; skin pinch goes back slowly. Dysentery (frequent loose stools mixed with blood) if any of the following criteria: <ul style="list-style-type: none"> • < 2 months old • severely ill children, who look lethargic, have abdominal distension and tenderness or convulsions 	

¹ICD-10: International Statistical Classification of Diseases and Related Health Problems, 10th revision [20]

²Based on the WHO *pocket book of Hospital care for children* [21].

Table S2. Standards of care for assessment of unnecessary and unnecessarily prolonged hospitalizations in pregnant women

Disease, condition (ICD-10 code ¹)	Hospitalization criteria ²	Discharge criteria ²
Threatened preterm labour up to 37 gestation weeks (O60)	Regular and irregular contraction of the uterus three or more in 30 minutes WITH at least one of the following: <ul style="list-style-type: none"> • Rupture of foetal membranes • Dilatation of the cervix of more than 2 cm • Smoothing of the cervix of more than 80% • Structural changes of the cervix • Pain in the lower abdomen increasing in intensity 	<ul style="list-style-type: none"> • No labour or contractions in 48 hours • Full course of the respiratory distress syndrome prevention, received at least 48 hours
Threatened miscarriages up to 22 gestation weeks (O20–O20.9)	ANY of the following: <ul style="list-style-type: none"> • Bloody discharge or bleeding • Cramping pains in the lower abdomen • Structural changes of cervix (the cervix skips the finger) 	<ul style="list-style-type: none"> • No bleeding in 24 hours
Premature rupture of membranes (O42.2)	ANY of the following: <ul style="list-style-type: none"> • Presence of amniotic fluid at instrumental examination with vaginal speculum • Presence of fluid on the control pad within one hour • Ultrasound examination suggestive of rupture of membranes 	<ul style="list-style-type: none"> • Ultrasound test (amniotic fluid normal) • Lack of amniotic fluid on control pad in 24 hours
Mild preeclampsia (O14.0)	<ul style="list-style-type: none"> • Blood pressure over 140/90 mmHg to 159/105 mmHg AND <ul style="list-style-type: none"> • Protein in urine 0.3 g/l to 3 g/l 	<ul style="list-style-type: none"> • Blood pressure below 130/80 mmHg for two days • Decreased urine protein below 0.2 g/l • Gestation weeks ≤ 37

¹ICD-10: International Statistical Classification of Diseases and Related Health Problems, 10th revision [20]

²Based on national protocols [23–28].