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Evaluation of the WHO standards to assess quality of care for children with acute respiratory infections: findings of a baseline multicentre assessment (CHOICE) in Italy

Marzia Lazzerini ,[1,2] Massimo Dagnelut,[3] Paolo Dalena ,[1,3] Idanna Sforzi ,[4] Maristella Toniutti,[5] Enrico Felici ,[6] Silvia Bressan ,[7] Gian Luca Trobia ,[8] Stefano Martelossi,[9] Riccardo Lubrano ,[10] Silvia Fasoli,[11] Federico Marchetti ,[12] Andrea Iuorio,[13] Chiara Grisaffi,[6] Silvia Galiazzo,[7] Francesca Patanè ,[14] Chiara Stefani,[9] Maria Luisa Casciana,[11] Angela Troisi ,[12] Egidio Barbi ,[1,3] on behalf of the CHOICE study group

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For numbered affiliations see end of article.

Correspondence to
Dr Paolo Dalena; paolo.dalena@burlo.trieste.it

ABSTRACT

Background Experience is lacking on the implementation of the WHO standards for improving the quality of care (QOC) for children at facility level. We describe the use of 10 prioritised WHO standard-based quality measures to assess provision of care for children with acute respiratory infections (ARI) in Italy.

Methods In a multicentre observational study across 11 emergency departments with different characteristics, we collected 10 WHO standard-based quality measures related to case management of children with ARI and no emergency/priority signs. Univariate and multivariate analyses were conducted.

Results Data from 3145 children were collected. Major differences in QOC across facilities were observed: documentation of saturation level and respiratory rate varied from 34.3% to 100% and from 10.7% to 62.7%, respectively (p<0.001); antibiotic prescription rates ranged from 22.6% to 80.0% (p<0.001), with significant differences in the pattern of prescribed antibiotic; hospitalisations rates ranged between 2.3% and 30.6% (p<0.001). When corrected for children's individual sociodemographic and clinical characteristics, the variable more consistently associated with each analysed outcome was the individual facility where the child was managed. Higher rates of antibiotics prescription (+33.1%, p<0.001) and hospitalisation (+24.7%, p<0.001) were observed for facilities in Southern Italy, while university centres were associated with lower hospitalisation rates (−13.1%, p<0.001), independently from children's characteristics.

Conclusions The use of 10 WHO standard-based measures can help quickly assess QOC for children with ARI. There is an urgent need to invest more in implementation research to identify sustainable and effective interventions to ensure that all children receive high QOC.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous studies highlighted gaps in the quality of care (QOC) for children with acute respiratory infections (ARI) in Europe, but limited evidence exists from Italy. WHO published in 2018 a set of standards for improving the QOC for children, but there is a lack of studies describing their implementation.

WHAT THIS STUDY ADDS

⇒ The utilisation of 10 prioritised WHO standard-based quality measures to assess provision of care for children with ARI in 11 Italian emergency departments revealed significant differences across hospitals, in particular on antibiotic prescription and hospitalisation rates, to a large extent independently from children characteristics.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The 10 WHO standard-based quality measures offer a rapid assessment of QOC in children with ARI and may be easily replicated in other settings. Policymakers should consider tailored interventions to improve and uniform practices of care for children with ARI.

BACKGROUND

Europe, North America and Australia are the regions worldwide with the lowest child mortality.[1] However, even in high-income countries, existing evidence documented substandard quality of care (QOC) in many settings.[2–13] A report from the WHO European Office highlighted a high rate of inappropriate hospitalisation and inappropriate use of antibiotics in children, with extreme variability across countries,[5] thus suggesting inequities in care provision. A multicountry survey conducted across European countries[6] observed that up to 67% of children accessing paediatric emergency departments (EDs) with upper respiratory tract infections were prescribed antibiotics, implying high health costs, and increasing risks of antibiotic resistance.[5 7] Large studies in the USA documented major variations across EDs in key aspects of provision of care to children—such as the use of chest X-ray for the diagnosis of respiratory diseases[8]—together with poor adherence to existing case management guidelines.[9]

In parallel, there is a dearth of up-to-date data on QOC for children, even on common conditions such as respiratory infections.[5 11] According to a recent survey, data on hospitalisation rate for pneumonia in children under 5 years of age were available in only 22 out of the 53 countries of the WHO European Region,[5] despite lower respiratory tract infections being still the first cause of death in children between 1 and 5 years of age globally.[10]

To contribute in accelerating the progress on paediatric QOC, WHO developed in 2018 a list of 'Standards to Improve the Quality of Care for Children and Young Adolescents at Facility Level'.[14] The WHO standards should be implemented in healthcare facilities following the 'Plan Do Study Act' cycle, which implies, as a first step, a baseline assessment using prioritised quality measures as more relevant to the local context.[14] However, there is lack of experience in using the paediatric WHO standards,[14] due also to their recent publication. In 2019, in dialogue with WHO, we established a multicountry project called Child HOspItal CarE (CHOICE), with the objective of conducting research to inform on most effective methods of implementation of the WHO standards, with focus in high-income and middle-income countries.[14] Preliminary products of the CHOICE study, including methods used to prioritise the WHO quality measures, development and validation of data collection tools, have been previously reported[15] and are synthetised in online supplemental table 1. This paper is part of a journal collection documenting key findings on the initial implementation (ie, the baseline assessment) of the WHO standard in the context of the CHOICE Study in Italy. Specifically, the present paper explores case management (eg, the domain of 'provision of care') for children with acute respiratory infections (ARI) and factors affecting it across facilities with different characteristics in Italy.

METHODS

Study design

This was a multicentre observational study, and it is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement.[16] The STROBE Checklist is provided as online supplemental table 2.

Study population

The study was conducted in 11 EDs, distributed across the Italian geographical territory (north, centre and south) and including facilities with different characteristics in terms of volume of work, facility level (referral facilities vs lower levels) and type (university vs non-university hospital), as detailed in online supplemental table 3.

Our inclusion criteria aimed at including children and adolescents with febrile ARI and no complications or underlying comorbidities. We included children and adolescents between 6 months and 15 years of age with a body temperature ≥38°C and either cough or other respiratory signs/symptoms (i.e., wheezing, rhinitis), accessing the EDs over 2 years (from January 2019 to December 2020). Children without fever and children classified according to the local triage system with either priority or emergency signs/symptoms as well as children with any underlying comorbidity (e.g., otitis, diffuse eczema, etc) which could have affected antibiotic prescription, were excluded.

Study variables and data collection

A set of 25 WHO quality measures to assess 'provision of care' in paediatric ED on 3 common paediatric conditions (ARI, acute diarrhoea and pain) was prioritised through a Delphi process[17] by a team of experts with long-term experience in developing and/or using WHO standards as well as other standards proposed by other scientific societies (details in online supplemental table 1). Among these 25 quality measures, 10 were pertinent to ARI, and specifically, 5 were pertinent to assessment and 5 to treatment (online supplemental table 1). Data on sociodemographic variables of children were also collected.

Data were extracted from discharge letters, which in Italy are the official written reports provided by the doctor in charge to the family at the time of discharge, including all relevant aspects of the child assessment and treatment. Cases were retrieved using ICD-10 (International Classification of Diseases, 10th Revision) diagnoses combined with a list of pretested keywords (ie, otitis, pharyngitis, nasopharyngitis, acute laryngitis, laryngotracheitis, laryngitis without mention of obstruction, viral infection, pneumonia, bronchopneumonia, bronchiolitis/bronchitis asthma, bronchospasm, tonsillitis, acute tonsillitis, respiratory system unspecified infection). Patients' records were selected at random among existing case records, and to avoid seasonality bias, the sample was equally distributed across seasons. According to the seasonal pattern of Italy, four seasons of 3 months each were identified. The tool for data extraction was conceptualised as a standardised Excel file containing clear instructions for compilation, and predefined fill-in tables. The tool was field tested in the hand of an independent data collector in a sample of 660 cases, and further optimised after field testing (eg, more comprehensive, and clear instructions were detailed and embedded in the tool). Data were extracted by trained researchers, under the supervision of an independent data analyst and of a senior paediatrician. The excel file was protected by a password.

Data analysis

The minimum sample size for inclusion for each hospital was 115 cases, based on an expected minimum frequency for each indicator of 4% and an absolute precision of 97.5%. For the year 2020, given the drastic reduction in access to paediatric EDs due to the COVID-19 pandemic, the sample was set as the maximum number of available cases with the given case definition in each facility.

First, we conducted a descriptive analysis of patients' characteristics and of results of the quality measures assessed. We also looked at types of antibiotics prescribed and type of hospitalisation (whether at short duration unit or formal hospitalisation). Data were presented as frequencies, by centre and on the overall sample. To study the differences in the frequency of quality measures between the data collected in the 2 years, the Wilcoxon-Mann-Whitney test for non-normally distributed data was applied.

We conducted univariate and multivariate logistic regression analyses, to assess the association between children individual characteristics (age, sex, temperature, oxygen saturation level, C reactive protein (CRP) level, oxygen support, results of the chest X-ray), including the centre where they were managed and the year, with the following three key quality measures): (1) antibiotic prescription at discharge from the ED, (2) clear indications for reassessment at discharge from the ED, and (3) hospitalisation. Three separate logistic regression models were estimated. Hospitalised children were excluded from the first and second models, since the quality measures under evaluation (ie, antibiotic prescription and clear indications for reassessment) were not pertinent to hospitalised children. In all models, the facility named C1 was taken as the reference value, since it was the coordinating facility of the CHOICE project. Multivariate logistic analysis was performed on all available variables, and then all variables that were significantly associated at the univariate level (considering an alpha equal to 0.10) were included in the multivariate logistic model. All multivariate models were also corrected for patient age. Frequencies, OR and adjusted OR (aOR) were calculated, with 95% CI and p values of significance.

Table 1 Linear regression models—associations between characteristics of the emergency departments (EDs) with antibiotic prescription and hospitalisation

	β coefficients	95% CI (lower)	95% CI (upper)	t value	Pr (>|t|)	
Variables associated with percentage of cases who received antibiotic prescription†						
(Intercept)	34.9	25.3	44.6	7.68	<0.001	***
Geographical location—north	20.1	9.69	30.5	4.09	0.001	**
Geographical location—south	33.1	20.4	45.9	5.51	<0.001	***
Number of ft paediatricians in ED in 2019/2020	0.587	−0.145	1.32	1.70	0.108	
Number of ft residents in paediatrics in 2019/2020	−0.300	−0.441	−0.159	−4.52	<0.001	***
Variables associated with percentage of cases hospitalised (in the ward or in the short stay unit)‡						
(Intercept)	6.34	−3.29	16.0	4.26	0.171	
Geographical location—north	−4.71	−9.76	0.332	2.23	0.064	
Geographical location—south	24.7	17.8	31.5	3.02	<0.001	***
University centre—yes	−13.1	−18.6	−7.67	2.42	<0.001	***
% Age 5–15 years	0.130	−0.0683	0.329	0.0878	0.172	
% Maximal temperature§ ≥40°C	−0.781	−1.20	−0.360	0.186	0.002	**
% SpO_2 ≥90%	3.93	−0.782	8.64	2.08	0.092	.
% CRP requested	0.309	0.156	0.462	0.0676	0.001	**
% RX requested	−0.194	−0.432	0.0442	0.105	0.099	
Children accessing the ED, per year (hundreds)	0.0574	0.0276	0.0872	0.0132	0.002	**
Ft paediatricians in ED in 2019/2020	−0.927	−1.36	−0.491	0.193	0.001	***
Ft residents in paediatrics in 2019/2020	0.250	0.177	0.324	0.0326	<0.001	***

If a p value is less than 0.05, it is flagged with one star (*). If a p value is less than 0.01, it is flagged with two stars (**). If a p value is less than 0.001, it is flagged with three stars (***).
†Multiple R-squared: 0.840, adjusted R-squared: 0.800, F-statistic: 21.06 on 4 and 16 DF, p value: <0.001.
‡Multiple R-squared: 0.963, adjusted R-squared: 0.917, F-statistic: 21.06 on 11 and 9 DF, p value: <0.001.
§Reported by parents or measured in ED.
CRP, C reactive protein; Ft, full time; RX, chest X ray; SpO2, oxygen saturation.

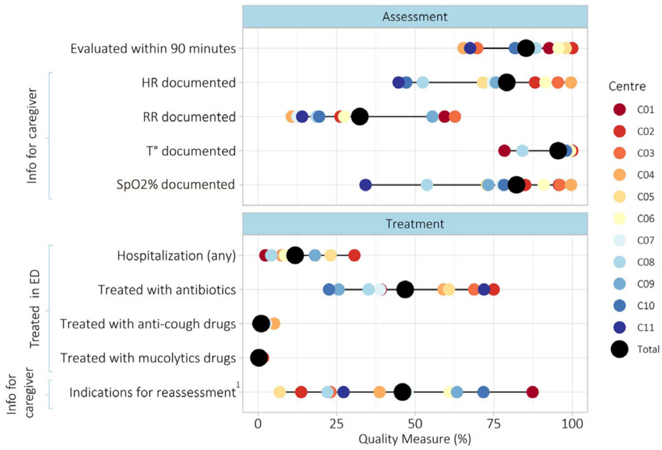

Figure 1 Findings on the 10 prioritised WHO standard-bases quality measures on paediatric ARI. Hospitalization (any) = both hospitalisation and short duration of stay. HR, heart rate; RR, respiratory rate; T°, body temperature (Celsius). SpO_2%, oxygen saturation. Ind, indication. [1]For C11, only 2019 data were available.

Moreover, to assess the association between two key quality measures (ie, hospitalisation and antibiotic prescription) and characteristics of each facility, when adjusted for characteristics of the population in each facility, we performed a multivariate analysis with a general linear model using gaussian family with identity link function. The independent variables included in this model for the key characteristics of each facility were as follows: geographical location, university centre, number of paediatricians, number of residents, number of nurses, percentage of CRP and chest X-ray requested. For the characteristics of the population in each facility, we included: % of children in each age class and sex class, % of children with maximum temperature ≥40 C°, % of children with oxygen saturation level ≥90%, % of children with CRP level ≥20 mg/L, % of children who received oxygen and % of children with a positive chest X-ray.

For the selection of the optimal model, an automatic backward elimination method was applied, based on the Akaike Information Criterion value. Findings were presented with β coefficients with 95% CIs and p values of significance. A p value of <0.05 was taken as statistically significant. R V.4.1.2 was used for data analysis.

RESULTS

Characteristics of the sample

A total of 3145 children accessing care in the ED of the 11 participating facilities were assessed (table 1). Children's age was distributed in the three age groups of children aged 6–23 months (37.5%), 24–59 months (35.6%) and 5–15 years (26.8%). Male sex was significantly more frequent than female (57.1% vs 42.9%, OR 1.77, 95% CI 1.60 to 1.96) across all but one facility (C11). Out of the total sample, about one-third (37.9%) of children had a maximum temperature over 39°C, while about two-thirds (61.8%) had values between 38°C and 39°C. Overall, about 1 out of 10 (11.2%) had a saturation level equal or below 92% during their stay in the ED. Among the 607 children who underwent blood tests, a value of CRP of at least 20 mg/L was detected in 242 (7.7% of total children). Out of the 390 children who underwent a chest X-ray, abnormalities were reported in 292 (9.3% of total children). Children's characteristics had significant variations across centres (online supplemental table 4).

Quality measures

The distribution of the quality measures across the 2 years was not statistically different (p values ranged from 0.27 to 0.80); therefore, results for the 2 years were analysed together. Most quality measures had large variations across centres (figure 1, details on online supplemental table 5A). Specifically, measures related to children assessment had major variations across facilities: the rate of children visited within 90 min ranged among centres from 65.4% to 100% (p<0.001); the rate of children in whom saturation level was documented varied from 34.3% to 100% (p<0.001); the rate of children in whom the heart rate and the respiratory rate were documented ranged from 52.4% to 99.6% and from 10.7% to 62.7%, respectively (p<0.001 for both). Temperature was overall better documented although with considerable variations across centres (range 78.4% to 100%, p<0.001).

Large heterogeneity across facilities was also observed for most quality measurers of treatment: the rate of antibiotic prescriptions ranged from 22.6% to 80.0% (p<0.001); the rate of children receiving clear written indications for reassessment in the discharge letter varied in between 6.8% and 87.3% (p<0.001), and the rate of hospitalisations had major variations (2.3%–30.6%, p<0.001). Large variations were also observed in the rate of short stay (range 0%–28.1% of children, p<0.001), with four facilities hospitalising children more often than keeping them in short stay (online supplemental table 5C).

When analysing types of antibiotics prescribed (online supplemental table 5B), amoxicillin was the most frequently prescribed antibiotic in 6 out of 11 centres (ranging from 6.4 to 36.1% of all prescriptions). Amoxicillin-clavulanic acid was the most prescribed antibiotic in four facilities (ranging from 0.5% to 36.8% of all prescriptions), while in one facility cephalosporins were prescribed in 42% of children with mild ARI (C2).

Factors associated with key quality measures

At the multivariate analysis, after correction for children's characteristics, the variable more strongly associated with each analysed quality measure was the facility where the child was managed. Specifically, for antibiotic prescription (figure 2A, online supplemental table 6), the analysis identified three groups of centres prescribing, when compared with the reference C1, significantly more antibiotics (C2, C3, C4 and C5, aOR range between 1.68 and 4.30), significantly less antibiotics (C8, C9 and C10, aOR range between 0.36 and 0.60), or about the same rate (C6

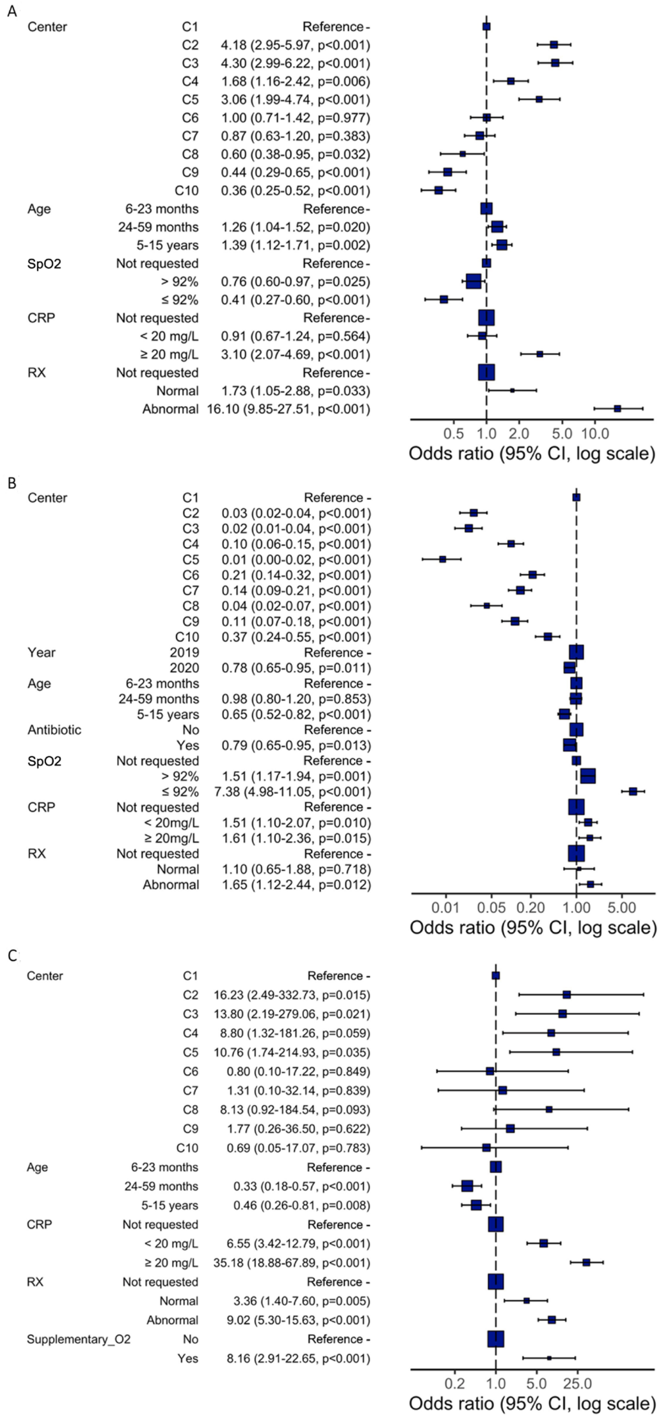

Figure 2 Factors significantly associated with antibiotic prescription (A), clear indications for reassessment (B) and hospitalisation (C). SpO_2, oxygen saturation; CRP, C reactive protein; RX, chest X ray.

and C7). Antibiotics were more likely to be prescribed to children with CRP ≥20 mg/L (aOR 3.10, 95% CI 2.07 to 4.69) and abnormal chest X-rays (aOR 16.10, 95% CI 9.85 to 27.51), while having an oxygen saturation level ≤92% resulted as a protective factor (aOR 0.41, 95% CI 0.27 to 0.60). Older children also, when corrected for other variables, had increased odds of antibiotic prescription (aOR equal to 1.26 and 1.39 when the child was aged between 24 and 59 months and older than 5 years, respectively).

For the availability in the discharge letter of clear indications for reassessment (figure 2B, online supplemental table 6), again, the centre where the child was managed was the variable more strongly associated with this quality measure, with all other centres having lower odds of providing clear indications for reassessment than the reference C1 (aOR range 0.01–0.37). Clear indications were most likely to be given to children with an oxygen saturation level ≤92% (aOR 7.38, 95% CI 4.98 to 11.05), CRP ≥20 mg/L (aOR 1.61, 95% CI 1.10 to 2.36) and abnormal X-rays (aOR 1.65, 95% CI 1.12 to 2.44). Being treated in 2020 (aOR 0.78, 95% CI 0.65 to 0.95), being older than 5 years (aOR 0.65, 95% CI 0.52 to 0.82) and having received antibiotics (aOR 0.79, 95% CI 0.65 to 0.95) were also associated with decreased odds of receiving clear indication for reassessment.

For hospitalisation (figure 2C, online supplemental table 6), again the centre where the child was managed was among the variables more strongly associated with the quality measure (aOR range between 10.76 and 16.23), although with larger CIs due to the low number of events (hospitalisations). Children who received oxygen had significantly higher odds of hospitalisation (aOR 8.16, 95% CI 2.91 to 22.65), while children of older age had lower odds (aOR equal to 0.33, 95% CI 0.18 to 0.57, and 0.46, 95% CI 0.26 to 0.81, when the child was aged between 24 and 59 months and older than 5 years, respectively),

The analysis of the associations between antibiotic prescription and hospitalisation rates with the facility characteristics, when corrected for the population of children accessing each facility (table 1), showed that the geographical location and being a university centre were the only factors strongly associated with these two outcomes. Specifically, being a facility in Southern Italy was associated with an increased prescription and hospitalisation rate by 33.1% (95% CI 20.4 to 45.9%, p<0.001) and 24.7% (95% CI 17.8 to 31.5%, p<0.001) respectively. Being a university centre associated with a rate of hospitalisation lower by −13.1% (95% CI −18.6 to −7.6%, p<0.001). Characteristics of the population in each facility did not significantly associate with antibiotic prescriptions rates. Only one children's characteristic had a significant although minor association with hospitalisation rates (temperature >40 C°, −0.8%, 95% CI − 1.2% to −0.4%, p=0.002). Other variables showed a statistically significant association, but the estimated value was negligible.

DISCUSSION

The CHOICE Project is the first project reporting on the implementation of the WHO 'Standards to Improve the Quality of Care for Children and Young Adolescents at Facility Level'.[14] This specific study brings several lessons. First, this study suggests that the use of the 10 WHO standard-based quality measures, as prioritised by the CHOICE Project, can help identify key gaps in the domain of provision of care for children with ARI. Second, the study generates new evidence on the QOC for children in EDs in Italy, in the lack of previous comprehensive assessments. Third, the comparison of the pre-pandemic to the pandemic period (year 2019 vs 2020) failed to identify a significant change in practices, suggesting that QOC for children with ARI was independent from the COVID-19 pandemic. Fourth, multivariate analyses showed higher rates of antibiotics prescription and hospitalisation for facilities in Southern Italy, in line with findings of other CHOICE studies, showing, for facilities in the South of Italy, a significantly higher hospitalisation and antibiotic prescription rate for children with acute diarrhoea (reference to Acute Diarrhea paper in the collection)[18] and a lower rate of pain measurement (reference to PAIN paper in the the collection).[19]

Although 10 quality measures may be regarded as a small number to assessed QOC for children with ARI, this may be considered sufficient to monitor key practices when sustainability is considered. The benefit versus the additional cost (time and human resources) of collecting more indicators on QOC for children with ARI should be carefully considered, if wishing to adopt these measures for routine monitoring, as suggested by WHO.[14] Other domains of QOC investigated by the CHOICE Study, such as experience of care, availability of resources (for the full list of 175 variables, see online supplemental table 1), as well as other indicators of provision of care relevant to other children's conditions, are reported in separated publications, and overall, provide an overview on 175 quality measures.

Overall study findings suggest that high QOC in paediatric EDs is in principle achievable, with several facilities showing good practices. Key gaps in provision of care observed may be synthesised in two categories: (1) the lack of documentation of vital signs and lack of written information for parents; (2) the tendency to overmedicalisation, with high antibiotic prescription and hospitalisation rates (values up to 80% and 30.6%, respectively). Multivariate analyses clearly showed high heterogeneity of practices across centres, independently from children clinical characteristics.

When aiming at comparing these findings to existing literature, we found a lack of comprehensive studies on QOC in paediatric ED. In a recent multicounty European survey in febrile children,[20] antibiotic prescriptions were classified as inappropriate in 12.5% of cases (range across EDs: 0.6%–29.3%), and inconclusive in 22.5% (range across EDs: 0.4%–60.8%). Previous studies in Italy on community acquired pneumonia at primary healthcare level reported that 53.3% of children received broad-spectrum therapy (amoxicillin/clavulanic acid, cephalosporins) and 30% macrolides, with increased odds of being prescribed large-spectrum antibiotics and/or macrolides for children older than 5 years and living in Central/Southern Italy.[21] Existing systematic reviews highlighted that antibiotics are the most frequently prescribed drug in paediatrics (accounting for 20%–33% of all paediatric drug prescription in population studies),[22 23] with large variations in prescription rates across countries, regions and single physicians.[24–26] Similarly, hospitalisation rates have been previously reported extremely variable, independently from children characteristics.[5 27] Other indicators of QOC assessed in this study for children with ARI have been poorly documented.

Overall, these data call for action at different levels—health authorities, hospital directors and single health professionals, locally and nationally—to uniform practices across facilities so that each child and their families can have access to high QOC. Approaches that, in randomised controlled trials, proved effective to improve QOC for children with ARI in EDs include the implementation of strict guidelines for hospitalisation,[28] clinical decision rules,[29–31] stewardship programmes on antibiotic prescriptions[32–34] and educational interventions for families.[35] These approaches also showed to enable cost saving by reducing hospitalisations and parental absenteeism from work.[31] Yet, there is an urgent need to invest more in implementation research to identify sustainable and effective interventions to improve QOC for children. Although there is no 'magic pill' to improve QOC,[36–38] study data strongly call for actions to reduce inequities in healthcare. The CHOICE study aims at supporting facilities in translating evidence into action, and its further results will be reported in future publications.

Low values of oxygen saturation in our sample, despite we had as exclusion criteria priority and emergency signs at the triage, shall be explained with children worsening their condition during their stay in ED. The finding that children with a lower saturation were less likely to receive antibiotics may be explained with these children having a viral bronchiolitis.

We acknowledge among limitations of this study the relatively small sample of facilities; however, the CHOICE study did not aim at collecting data from a large sample of facilities, but rather, in the lack of previous experience, at generating lessons on the implementation WHO standards,[14] useful for future large-scale implementation efforts.

Findings of this study may have been affected by reporting bias in medical files. Specifically, underreporting of measurement of vital sign and written information for patients may have overestimated gaps in QOC. On the other side, antibiotic prescription, which was extracted from the patient's medical ED records, may have missed additional antibiotics prescribed to children transferred to other departments (including the paediatric ward), thus underestimating the actual rate of antibiotic prescriptions. Completeness of ED discharge letter is not a trivial issue, it is critical to allow clinical follow-up of children, and it is also a fundamental right of patients,[12 14] so it could be considered one of the objectives of quality improvement interventions.

While results of this study cannot be directly generalised to other facilities, the methods used could be easily replicated. Standardised systems to routinely measure and compare over time different domains of QOC for children are still lacking in many countries including high-income countries, and these data are not readily available to inform policy and action in a timely manner.[14 39] Systems to monitor QOC across countries and over time are urgently needed, even in the WHO European Region. Ideally, such systems should aim at linking, as done in this study, quality measures to the individual children and facility characteristics. The WHO standards should be promoted, upheld and routinely monitored over time, including during times of crisis, such as the current global COVID-19 pandemic. Further research is needed to evaluate how to better incorporate quality assessments in routine data collection systems, and how to efficiently triangulate data from different sources with other indicators such as health outcomes. In the current lack of a national monitoring system, multicentre research collaborations appear as critical to foster the implementation of the WHO standards.[28 29]

Author affiliations

[1]Institute for Maternal and Child Health IRCCS Burlo Garofolo, Trieste, Italy
[2]London School of Hygiene & Tropical Medicine, London, UK
[3]University of Trieste, Trieste, Italy
[4]Department of Pediatric Emergency Medicine and Trauma Center, Meyer Children's Hospital IRCCS, Florence, Italy
[5]Santa Maria della Misericordia University Hospital, Udine, Friuli-Venezia Giulia, Italy
[6]Azienda Ospedaliera Nazionale Santi Antonio e Biagio e Cesare Arrigo Alessandria, Alessandria, Piemonte, Italy
[7]Department of Women's and Children's Health, University of Padova, Padova, Italy
[8]Cannizzaro Hospital, Catania, Sicilia, Italy
[9]Department of Pediatrics, Treviso Hospital, Treviso, Italy
[10]Department of Pediatrics Sapienza University of Rome, Santa Maria Goretti Hospital, Latina, Italy
[11]Department of Pediatrics, "Carlo Poma" Hospital, Mantova, Italy
[12]Department of Pediatrics, Santa Maria delle Croci Hospital, Ravenna, Italy
[13]Pediatric Hematology and Oncology, IRCCS Azienda Ospedaliero-Universitaria di Bologna, IRCCS Azienda Ospedaliero-Universitaria di Bologna Policlinico di Sant'Orsola, Bologna, Italy
[14]Santa Marta e Santa Venera Hospital, Acireale Catania, Italy

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Collaborators Alessandria: Marta Gagliardi, Kevin Valentino, Chiara Grisaffi, Bari: Fabio Cardinale, Annunziata Lucarelli, Lucia Grazia Tricarico, Mariateresa De Sario, Alessandra Pisani; Catania: Maria Carla Finocchiaro, Laura Portale, Marta Arrabito, Vita Antonella Di Stefano; Firenze: Stefano Masi, Marco Greco, Emiliano Talanti, Anna Madera, Paola Stillo, Rosa Santangelo, Nicolò Chiti, Latina: Vanessa Martucci, Mariateresa Sanseviero, Silvia Bloise, Alessia Marcellino; Mantova: Silvia Sordelli, Mariangela Labruzzo; Padova: Francesca Tirelli; Palermo: Massimo Lo Verde, Domenico Cipolla, Sarah Contorno, Roberta Parrino, Giuseppina De Rosa; Ravenna: Sara Dal Bo, Alessandra Iacono, Vanna Graziani, Carlotta Farneti, Francesco Oppido, Giulia Sansovini; Treviso: Marcella Massarotto, Paola Crotti, Giada Sartor, Benedetta Ferro, Riccardo Pavanello, Marta Minute, Paola Moras; Trieste: Ilaria Mariani, Elia Balestra, Benmario Castaldo, Marta Magnolato, Michele Maiola, Giorgio Cozzi, Alessandro Amaddeo, Alice Del Colle; Udine: Ilaria Liguoro, Michela Pandullo, Sara Rivellini, Chiara Pilotto, Paola Cogo.

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Patient and public involvement Both health service users (children and their parents) and health providers (health workers at facility level) were involved in the CHOICE (Child HOspItal CarE) study in multiple stages. As a first step, in 2019-2020 they were involved in the prioritization of Quality Measures, thus affecting the selection of research outcomes. Secondly, they were involved in the validation of data collection tools,[15] which included collecting their opinion on the acceptability of the questionnaire. Lastly, their opinion on quality of care was actively collected; more specifically, the option of service users was collected on 75 prioritized Quality Measure,[40] and the opinion of service providers was collected on another 75 prioritized Quality Measure.[41] In each facility health workers were involved in the dissemination of study findings (year 2022-2023), and in planning quality improvement interventions. In the nearest future we plan to further involve the general public in data dissemination.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval Approval for data collection was obtained by the Ethical Committee of the Friuli Venezia Giulia Region for the coordinating centre (Study ID: 2976, RC 15/2019 Prot. 0035348, 3 December 2019) and by the ethical committees of each participating hospital. Anonymity in data collection was ensured by not collecting any information that could disclose participants' identity. Participants gave informed consent to participate in the study before taking part.

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ORCID iDs

Marzia Lazzerini http://orcid.org/0000-0001-8608-2198
Paolo Dalena http://orcid.org/0000-0003-2920-9572
Idanna Sforzi http://orcid.org/0000-0002-3445-8963
Enrico Felici http://orcid.org/0000-0002-5997-7057
Silvia Bressan http://orcid.org/0000-0002-6736-5392
Gian Luca Trobia http://orcid.org/0000-0002-6943-4638
Riccardo Lubrano http://orcid.org/0000-0001-8237-955X

Federico Marchetti http://orcid.org/0000-0002-1257-7312
Francesca Patanè http://orcid.org/0009-0000-9713-6366
Angela Troisi http://orcid.org/0000-0001-9457-3974
Egidio Barbi http://orcid.org/0000-0002-6343-846X

REFERENCES

1 UNICEF, WHO, World Bank, UN-DESA Population Division. *Levels & trends in child mortality report 2021. Estimates developed by the U Inter-Agency Group for Child Mortality Estimation*. Geneva: United Nations Children's Fund, 2020. Available: https://data.unicef.org/resources/levels-and-trends-in-child-mortality/
2 World Health Organization, OECD & International Bank for Reconstruction and Development. *Delivering quality health services: a global imperative for universal health coverage*. World Health Organization, 2018. Available: https://apps.who.int/iris/handle/10665/272465
3 Makary MA, Daniel M. Medical error—the third leading cause of death in the US. *BMJ* 2016;353:i2139.
4 National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Care Services; Board on Global Health; Committee on Improving the Quality of Health Care Globally. *Crossing the global quality chasm: improving health care worldwide*. Washington (DC): National Academies Press (US), 2018.
5 World Health Organization. *Situation of child and adolescent health in Europe*. World Health Organization, 2018.
6 van de Maat J, van de Voort E, Mintegi S, *et al*. Antibiotic prescription for febrile children in European emergency departments: a cross-sectional, observational study. *Lancet Infect Dis* 2019;19:382–91.
7 European Centre for Disease Prevention and Control. Antimicrobial resistance in the EU/EEA (EARS-Net)Annual epidemiological report for 2019. Available: https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-resistance-europe-2019 [Accessed 5 Mar 2020].
8 Michelson KA, Lyons TW, Hudgins JD, *et al*. Use of a national database to assess pediatric emergency care across United States emergency departments. *Acad Emerg Med* 2018;25:1355–64.
9 Jain S, Cheng J, Alpern ER, *et al*. Management of febrile neonates in US pediatric emergency departments. *Pediatrics* 2014;133:187–95.
10 Perin J, Mulick A, Yeung D, *et al*. Global, regional, and national causes of under-5 mortality in 2000-19: an updated systematic analysis with implications for the sustainable development goals. *Lancet Child Adolesc Health* 2022;6:106–15.
11 Leary JC, Walsh KE, Morin RA, *et al*. Quality and safety of pediatric inpatient care in community hospitals: a scoping review. *J Hosp Med* 2019;14:694–703.
12 World Health Organization. *Every woman every child. Global strategy for women's, children's and adolescents health 2016–2030*. Geneva: World Health Organization, 2016. Available: http://www.who.int/life-course/partners/global-strategy/global-strategy-2016–2030/en/
13 Requejo J, Strong K, Agweyu A, *et al*. Measuring and monitoring child health and wellbeing: recommendations for tracking progress with a core set of indicators in the sustainable development goals era. *Lancet Child Adolesc Health* 2022;6:345–52.
14 World Health Organization. *WHO standards to improve the quality of care for children and young adolescents at facility level*. Geneva: World Health Organization, 2018.
15 Lazzerini M, Mariani I, de Melo E Lima TR, *et al*. WHO standards-based tools to measure service providers' and service users' views on the quality of hospital child care: development and validation in Italy. *BMJ Open* 2022;12:e052115.
16 Elm E von, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ* 2007;335:806–8.
17 McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clin Pharm* 2016;38:655–62.
18 Lazzerini M, Sforzi I, Liguoro I, *et al*. Implementation of the WHO standards to assess the quality of care for children with acute diarrhoea: findings of a multicentermulticentre study (CHOICE) in Italy. *BMJ Paediatr Open* 2024;0:e002569.
19 Balestra E, Cozzi G, Sforzi I, *et al*. Implementation of the WHO standards to assess quality of care for children with acute pain in EDs: findings of a multicentere study (CHOICE) in Italy. *BMJ Paediatr Open* 2024;0:e002610.
20 Hagedoorn NN, Borensztajn DM, Nijman R, *et al*. Variation in antibiotic prescription rates in febrile children presenting to emergency departments across Europe (MOFICHE): a multicentre observational study. *PLoS Med* 2020;17:e1003208.
21 Costenaro P, Cantarutti A, Barbieri E, *et al*. Antibiotic prescriptions for children with community-acquired pneumonia: findings from Italy. *Pediatr Infect Dis J* 2021;40:130–6.
22 Clavenna A, Bonati M. Drug prescriptions to outpatient children: a review of the literature. *Eur J Clin Pharmacol* 2009;65:749–55.
23 Clavenna A, Bonati M. Differences in antibiotic prescribing in paediatric outpatients. *Arch Dis Child* 2011;96:590–5.
24 Taine M, Offredo L, Weill A, *et al*. Pediatric outpatient prescriptions in countries with advanced economies in the 21st century: a systematic review. *JAMA Netw Open* 2022;5:e225964.
25 Di Martino M, Lallo A, Kirchmayer U, *et al*. Prevalence of antibiotic prescription in pediatric outpatients in Italy: the role of local health districts and primary care physicians in determining variation. A multilevel design for healthcare decision support. *BMC Public Health* 2017;17:886.
26 McKay R, Patrick DM, McGrail K, *et al*. Antibiotic prescribing for pediatric respiratory infections: what explains a large variation among physicians *Can Fam Physician* 2019;65:e278–91.
27 Poropat F, Heinz P, Barbi E, *et al*. Comparison of two European paediatric emergency departments: does primary care organisation influence emergency attendance? *Ital J Pediatr* 2017;43:29.
28 Havdal LB, Nakstad B, Fjærli HO, *et al*. Viral lower respiratory tract infections-strict admission guidelines for young children can safely reduce admissions. *Eur J Pediatr* 2021;180:2473–83.
29 van de Maat JS, Peeters D, Nieboer D, *et al*. Evaluation of a clinical decision rule to guide antibiotic prescription in children with suspected lower respiratory tract infection in the Netherlands: a stepped-wedge cluster randomised trial. *PLoS Med* 2020;17:e1003034.
30 Hagedoorn NN, Wagenaar JHL, Nieboer D, *et al*. Impact of a clinical decision rule on antibiotic prescription for children with suspected lower respiratory tract infections presenting to European emergency departments: a simulation study based on routine data. *J Antimicrob Chemother* 2021;76:1349–57.
31 van de Maat J, van der Ven M, Driessen G, *et al*. Cost study of a cluster randomized trial on a clinical decision rule guiding antibiotic treatment in children with suspected lower respiratory tract infections in the emergency department. *Pediatr Infect Dis J* 2020;39:1026–31.
32 Rossin S, Barbieri E, Cantarutti A, *et al*. Multistep antimicrobial stewardship intervention on antibiotic prescriptions and treatment duration in children with pneumonia. *PLoS One* 2021;16:e0257993.
33 Donà D, Barbieri E, Daverio M, *et al*. Implementation and impact of pediatric antimicrobial stewardship programs: a systematic scoping review. *Antimicrob Resist Infect Control* 2020;9:3.
34 Yadav K, Meeker D, Mistry RD, *et al*. A Multifaceted intervention improves prescribing for acute respiratory infection for adults and children in emergency department and urgent care settings. *Acad Emerg Med* 2019;26:719–31.
35 Stockwell MS, Catallozzi M, Larson E, *et al*. Effect of a URI-related educational intervention in early head start on ED visits. *Pediatrics* 2014;133:e1233–40.
36 Yates TD, Davis ME, Taylor YJ, *et al*. Not a magic pill: a qualitative exploration of provider perspectives on antibiotic prescribing in the outpatient setting. *BMC Fam Pract* 2018;19:96.
37 Ku BC, Chamberlain JM, Shaw KN. Quality improvement and safety in pediatric emergency medicine. *Pediatr Clin North Am* 2018;65:1269–81.
38 Migita R, Yoshida H, Rutman L, *et al*. Quality improvement methodologies: principles and applications in the pediatric emergency department. *Pediatr Clin North Am* 2018;65:1283–96.
39 Strong KL, Requejo J, Agweyu A, *et al*. Revitalizing child health: lessons from the past. *Glob Health Action* 2021;14:1947565.
40 Bressan S, Sartor G, Dalena P, *et al*. Implementation of the WHO Standards to assess quality of paediatric care at the facility level using service users' perspective as source of data: a multicentre quality improvement study in Italy. *BMJ Paediatr Open* 2024;0:e002600.
41 Liguoro I, Mariani I, Iuorio A. Implementation of the WHO Standards to assess the quality of paediatric care using health workers as source of data: findings of a multicentre study (CHOICE) in Italy. *BMJ Paediatr Open* 2024;0:e002612.