Caregiver Views and Practices Regarding Children's Antibiotic Suspensions in Lebanon

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ABSTRACT

Lebanon grapples with the pressing challenge of pediatric antibiotic misuse. To tackle this issue, we conducted a cross-sectional study in Beirut aimed at assessing caregivers' knowledge and practices regarding children's antibiotic suspensions. A total of 113 caregivers were interviewed at pharmacies to evaluate their comprehension of medication instructions, dosing accuracy, storage/disposal practices, and satisfaction with pharmacist counseling. Results indicated that while 67.3 % of caregivers demonstrated a clear understanding of medication instructions and 63.7 % followed proper reconstitution, concerning practices surfaced. Notably, 71.7 % of caregivers stored leftover suspensions in kitchens. However, 56.6 % correctly disposed of them. Widespread use of cold mineral water as a diluent (66.4 %) contradicts guidelines. Pharmacists played a crucial role, with 69.1 % of caregivers receiving counseling, yet averaging only 3.7 minutes, suggesting room for improvement. Significant correlations emerged between accurate understanding and proper reconstitution ($p < 0.001$). These findings highlight the need for clearer instructions for caregivers, educational initiatives on appropriate storage and disposal, and enhanced training for pharmacists. Addressing these aspects can improve health outcomes in Lebanon and contribute to the global fight against antibiotic resistance.

Keywords: Antibiotic suspension use; Caregivers; Knowledge and practices; Drug administration; Optimization; Pharmacist counseling

INTRODUCTION

Antimicrobial resistance (AMR) has been deemed a global health emergency by the World Health Organization (WHO) and the United Nations (UN) General Assembly (1). It poses a threat to the life-saving power of antibiotics, causing millions of deaths annually, particularly in low- and middle-income countries (2,3). Factors contributing to this issue include misuse, limited diagnostic methods, and the presence of antibiotics in the environment (4). Addressing this requires improved infection prevention, increased diagnostic accessibility, and antibiotic stewardship (5).

In Lebanon, antibiotic misuse is widespread, ranging from 42 % to 63 %, with 22 % self-prescribing and 7 % following non-medical advice, straining public healthcare systems and fueling the emergence of AMR (6,7). This rising problem of AMR poses a critical challenge in the treatment of common infections, particularly for children with underdeveloped immune systems and those living in poverty (8,9). Optimizing antibiotic use, especially for children, is crucial to reduce treatment failures, minimize side effects, and promote better long-term health outcomes (10). Similarly, a study in Jordan by Ayyash et al. revealed

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that, despite a good level of knowledge regarding antibiotics, misconceptions and improper use persisted, emphasizing the need for focused educational efforts to address these practices (11). Likewise, research by Sonji et al. in Lebanon highlighted a knowledge-practice gap among pharmacy students regarding food labels, further underscoring the importance of addressing such gaps through targeted education (12).

The COVID-19 pandemic in Lebanon has led to increased antibiotic use, emphasizing the urgency of awareness and control measures (13). While urban residents in Lebanon generally have a good understanding of antibiotics, due to better access to healthcare facilities and educational resources, Beirut faces particular challenges due to misconceptions, which necessitate educational campaigns to curb misuse and combat AMR (14,15).

There is a significant research gap regarding the appropriate usage and teaching of antibiotic suspensions. Recent research indicates that caregivers often lack understanding of the correct amount and duration of antibiotic administration for children. For example, some caregivers may discontinue the antibiotic course once the child's symptoms improve, which can lead to inadequate treatment and potentially contribute to AMR (16–18). Additionally, there is a lack of comprehensive information on the proper instruments and practices for administering antibiotic suspensions to children, leading to either ineffective therapy or unnecessary exposure to antibiotics (19,20). Improper storage and disposal methods can reduce antibiotic effectiveness and contribute to environmental pollution (21,22). Furthermore, the impact of antibiotic suspensions on the development of AMR has not been adequately studied (23,24).

This study tackles pediatric antibiotic misuse in Beirut, Lebanon, where knowledge gaps exist regarding caregiver practices for antibiotic suspensions. To bridge this gap and optimize antibiotic use, we assessed caregiver knowledge and practices concerning reconstitution, storage, dosing, and disposal. We also evaluated their understanding of medication instructions, storage conditions, and disposal methods for antibiotic suspensions, and investigated the role of pharmacist counseling on caregiver knowledge and practices related to antibiotic use. This comprehensive approach aims to inform interventions that will ensure optimal health outcomes for children in Beirut.

METHODOLOGY

Study Design and Data Collection

This study utilized a cross-sectional design to evaluate caregiver knowledge and practices concerning antibiotic suspensions in children. Data was collected through face-to-face questionnaires administered to 113 customers at community pharmacies in Beirut, Lebanon. A convenience sampling method was used to recruit participants who were visiting pharmacies to purchase or pick up antibiotic suspensions for children. Data collection occurred between November 2022 and June 2023.

Inclusion/Exclusion Criteria

The selection of research participants was based on predetermined inclusion and exclusion criteria. Eligible participants were individuals who were purchasing an antibiotic suspension for a child under 12 years old and were at least 18 years old. Additionally, participants needed to demonstrate their ability to comprehend the questions and respond in either Arabic or English. This requirement was put in place to ensure consistent data collection that could be accessed by a wider audience. To accommodate the participants' preferred language, the questionnaire was administered in both Arabic and English. Out of the 113 people surveyed, 48 responded in Arabic, and 65 responded in English. Conversely, the study excluded individuals who were unable to understand the questionnaire due to cognitive or language limitations.

Sample Size

This study employed a convenience sampling method for participant recruitment. A power analysis was conducted before data collection to determine the necessary sample size to detect a moderate effect size with

a high level of statistical power. The analysis targeted an effect size of 0.5 for the primary outcome measure (patient satisfaction) and a desired alpha level of 0.05. This indicated a sample size of 86 participants would be required to achieve a power level of 0.90. A total of 113 caregivers of children in Beirut, Lebanon, participated in the study, exceeding the target sample size and further strengthening the generalizability of the findings.

Ethical Considerations

This study was approved by the Institutional Review Board of Lebanese International University (LIU), and written informed consent was obtained from all participants before data collection.

Questionnaire Design

The study utilized a face-to-face questionnaire designed to assess various aspects of caregivers' knowledge and practices regarding antibiotic suspensions for children with a particular focus on understanding factors affecting satisfaction with pharmacist counseling. The questionnaire was developed based on a review of previous studies (25,26) and covered various domains. These domains included demographic information (age, gender, education level, child relationship) to understand the participant pool. Additionally, it assessed caregivers' ability to read and understand pamphlet instructions for medication use. Furthermore, the questionnaire explored practices related to reconstituting, administering, and storing antibiotic suspensions to determine adherence to proper procedures. Finally, it included questions to assess caregiver satisfaction with pharmacist counseling, such as the time spent discussing medications, the adequacy of information provided, and caregivers' perceptions of the pharmacist's attentiveness and communication skills**.** By analyzing responses to these questions, we aimed to identify which aspects of pharmacist counseling (e.g., time spent, information adequacy, communication skills) contribute most to caregiver satisfaction. A 5-point Likert scale was used to measure satisfaction with different aspects of the counseling received by caregivers, ranging from 1 (strongly disagree/dissatisfied) to 5 (strongly agree/satisfied). The mean score of all responses was then calculated to obtain an overall satisfaction score.

To ensure accessibility for Beirut's diverse population, the questionnaire was translated into Arabic by two bilingual translators. Discrepancies were resolved through consensus meetings and a third bilingual translator performed a back-translation. The research team compared the back-translation to the original English version to ensure accuracy.

Data Collection

Data was collected by a single trained research assistant who conducted all interviews with the participants. This approach was chosen to maintain consistency in data collection procedures and to minimize variability in how questions were asked and responses were recorded.

Validity and Reliability

The questionnaire was assessed for content validity by a panel of experts in pharmacy and pediatrics. The internal consistency of the questionnaire was evaluated using Cronbach's alpha coefficient, which was deemed acceptable (>0.8) for all domains.

Assessment of Interviewers' Practices

To evaluate the interviewers' practices, their actions were compared with the instructions on the drug boxes and package inserts for each antibiotic used. This was done by observing the interviews and reviewing the completed questionnaires. Any discrepancies were noted and addressed with the interviewers to ensure consistency.

Pharmacist counseling was assessed by asking participants to recall the information they received from the pharmacist about the antibiotic suspension. Patient satisfaction was measured using a 5-point Likert scale for various aspects of the care they received.

Statistical Analysis

Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 26.0 software. Descriptive statistics (means, standard

deviations, frequencies, and percentages) were used to summarize the data. One-sample t-tests were employed to assess whether caregivers' mean satisfaction scores significantly differed from a neutral satisfaction point (3.0) for various aspects of pharmacist interactions. Correlation analysis was used to examine the relationships among different satisfaction measures. The level of significance was set at $p < 0.05$.

RESULTS

The participants in this study (n=113) were primarily females (76.1 %), representing mothers caring for their children (62.8 %). Ages ranged from 20 to 41 years, with the largest group belonging to the more than 41 age (33.6 %). Educational attainment showed a high level of qualification, with over half (54.9 %) holding university degrees. Employment status indicated that most participants (70.8 %) were currently employed. Family size primarily consisted of one to three children (86.7 %), with the majority of children falling above the age of five (58.4 %) (Table 1).

Table 1. Socio-demographic characteristics of caregivers

Characteristics	Frequency(Percentage)
Gender	
Male	27(23.9 %)
Female	86(76.1 %)
Relation to the patient	
Father	23(20.4 %)
Mother	71(62.8 %)
Brother/sister	12(10.6 %)
Other	7(6.2 %)
Age	
Less than 20 yo	7(6.2 %)
20 to 30 yo	31(27.4 %)
31 to 40 yo	37(32.7 %)
More than 41 yo	38(33.6 %)
Education level	
School Education	51(45.1 %)
University Education	62(54.9 %)
Work	
Yes	80(70.8 %)
No	33(29.2 %)
Number of children	
1	27(23.9 %)
2	50(44.2 %)
3	21(18.6 %)
More than 3	15(13.3 %)
Child’s age (years old)	
Less than 1 yo	8(7.1 %)
1 to 3 yo	16(14.2 %)
3 to 5 yo	23(20.4 %)
More than 5 yo	66(58.4 %)

Table 2 provides a comprehensive overview of recommended reconstitution methods, water choices, and storage conditions. Only two-thirds (63.7 %) followed the recommended gradual addition technique, which involves

adding water in stages with shaking. Practices such as direct addition (15.9 %) and halfway split (20.4 %) were also observed. Cold mineral water emerged as the preferred diluent for most participants (66.4 %), followed by hot mineral water (14.2 %) and boiled and cooled mineral water (10.6 %) (Table 2).

Kitchen cabinets (71.7 %) were the most common location chosen for storing antibiotic powder, followed by living rooms (28.3 %) (Table 2). Participants' estimates for storage duration varied. Some estimated a two to three-year lifespan (33.6 %), while others estimated shorter durations (12.4 % believing less than a week) or longer lifespans (16.8 % assuming one year). Reconstituted suspensions were primarily stored in the refrigerator (65.5 %) (Table 2). Beliefs about reconstituted suspension lifespan also varied. Over half (56.6 %) believed it lasted seven days, but some had different estimations: 15.9 % thought two to three days, and 7.1 % believed it lasted more than a month.

Table 2. Methods, Water Choices, and Storage Conditions for Powder & Reconstituted Suspension

Practice	Frequency(Percentage)	Recommended
Reconstitution Method		
Gradual Addition (Tap bottle to loosen the powder, add half the volume of water, shake well, add remaining water, shake well)	72(63.7 %)	Yes
Direct Addition (Add all water, shake well)	18(15.9 %)	No
Halfway Split (add half the volume of water, shake well, add remaining water, dispense without shaking)	23(20.4 %)	No
Water Choices		
Boiled and cooled tap water	4(3.5 %)	Yes
Boiled and cooled mineral water	12(10.6 %)	No
Cold tap water	3(2.7 %)	No
Cold mineral water	75(66.4 %)	No
Distilled water	3(2.7 %)	Yes
Hot mineral water	16(14.2 %)	No
Storage Locations of Antibiotic Powder		
Kitchen cabinets	81(71.7 %)	No
Living rooms	32(28.3 %)	No
Storage Temperature of Powder		
25ºC	80(70.8 %)	Yes
37ºC	8(7.1 %)	No
18ºC	25(22.1 %)	No
Shelf Life of Powder		
Less than 1 week	14(12.4 %)	No
1 week	33(29.2 %)	No
1 year	19(16.8 %)	No
2 to 3 years	38(33.6 %)	Yes
More than 3 years	9(8 %)	No
Storage Temperature of Reconstituted Powder		
Refrigerator	74(65.5 %)	Yes
Room temperature	39(34.5 %)	No
Shelf Life of Reconstituted Powder		
2 to 3 days	18(15.9 %)	No
7 days	64(56.6 %)	Yes
10 to 14 days	23(20.4 %)	No
More than a month	8(7.1 %)	No

Table 3 presents caregiver practices in administering antibiotic suspensions, showing frequencies and percentages related to various aspects of administration and dosing tools. The majority of caregivers demonstrated consistent behaviors in reading instructions (67.3 %) and understanding provided information (67.3 %). When it came to selecting dosing tools, syringes were the preferred choice, used by 34.5 % of participants. However, a significant number of caregivers also mentioned using medicinal spoons (30.1 %), household teaspoons (17.7 %), and household cups (4.4 %) for administering antibiotic suspensions. In terms of dosing practices and hygiene, almost all caregivers (96.5 %) reported following recommended hygiene practices for dosing tools, such as washing hands and following cleaning instructions.

Table 3: Caregiver Practices in Antibiotic Suspension Administration

	Frequency(Percentage)
Category	
Reading instructions	76(67.3 %)
Understanding provided info	76(67.3 %)
Choice of dosing tools	
Syringes	39(34.5 %)
Medicinal spoons	34(30.1 %)
Medicinal cups	15(13.3 %)
Household teaspoons	20(17.7 %)
Household cups	5(4.4 %)
Dosing Practices	
Dosing tools hygiene*	
Yes	109(96.5 %)
No	4(3.5 %)

* Washing hands, following cleaning instructions

A one-sample t-test was employed to assess whether caregivers' mean satisfaction scores significantly differed from a neutral satisfaction point. Caregivers reported a mean satisfaction score of 3.7 for the time pharmacists dedicated to discussing medications, significantly higher than the neutral point of 3.0 (p=0.001). Similarly, the adequacy of counseling yielded a mean score of 3.66, also significantly higher than neutral (p=0.002). These results indicate that both time spent and counseling adequacy are key factors enhancing caregiver satisfaction. Correlation analysis supported these findings, with strong positive correlations for time spent (coefficient=0.62, p=0.001) and counseling adequacy (coefficient=0.51, p=0.001). In contrast, moderate correlations were found for medical history inquiry (coefficient=0.45) and antibiotic follow-up (coefficient=0.38), with non-significant t-test results (p=0.123 and p=0.210, respectively). This study revealed positive trends, with a high percentage of participants receiving counseling on crucial topics: 69.1 % on side effects, 75.5 % on administration frequency, and 66.4 % on reconstitution techniques. Notably, 90.5 % of caregivers learned about the importance of shaking the medication, a vital step for proper medication dispersal.

DISCUSSION

The proper use of antibiotics is crucial for combating AMR, a significant global health threat, particularly in pediatric populations (27). Antibiotic reconstitution practices, particularly the seemingly simple step of tapping the bottle to loosen the powder, require greater attention than previously recognized (28). While a large majority (63.7 %) followed the recommended "gradual addition" method, a considerable number of caregivers (36.3 %) used potentially inaccurate methods. Studies by Kumarasinghe et al. and Parihar et al. found even higher percentages (46.3 % and 65.0 %, respectively) of participants who did not shake the reconstituted suspension before each dose (28,29). Failing to shake the suspension can lead to uneven distribution of medication, potentially causing inaccurate dosing and reduced effectiveness (30). Deviation from the recommended reconstitution method was observed, with some caregivers adding all the water at once (15.9 %) or half at a time (20.4 %), raising concerns about accurate dosing. This finding is consistent with both Al-Ramahi et al. (deviations in adding water) and Olorukooba et al. (issues with reconstitution

techniques) (31,32). Educational initiatives focusing on reconstitution techniques and suspension shaking are crucial for caregivers to ensure safe and effective antibiotic use in children (23).

A concerning trend was identified in the water choices used for reconstituting antibiotic suspensions. Only a small percentage (3.5 %) used the recommended boiled and cooled tap water or distilled water (2.7 %), while the majority (66.4 %) adopted cold mineral water. This deviates from recommendations that advocate for distilled or boiled and cooled tap water (33). The use of water sources like cold tap water (2.7 %) and hot mineral water (14.2 %) is particularly worrying. Studies have shown that unboiled tap water can contain bacteria, and the composition of mineral water can impact the effectiveness of some antibiotics (34,35). Our findings align with Aika et al., who discovered that a majority of caregivers (71.7 %) believe that hot or warm water can be used to reconstitute antibiotics (26). However, they contrast the findings of Al-Ramahi et al. who reported that 75.5 % of mothers were using boiled and cooled tap water in line with recommendations (31). Olorukooba et al. also observed that 59.4 % of caregivers use bottled water, emphasizing the importance of educating individuals on best practices in different regions (32).

A positive finding is that the majority of caregivers stored the powder at the recommended temperature of 25°C (70.8 %). However, improper storage locations like kitchen cabinets (71.7 %) and living rooms (28.3 %) were concerning. Similar findings regarding improper storage locations were reported by Alsabra et al. and contrast with the results of Al-Ramahi et al. (18.0 % in the kitchen and 12.0 % in dining rooms) (31,36). Exposure to heat, light, or moisture in these locations can degrade the medication (22,37). A significant portion of caregivers underestimated the shelf life of both the powder and reconstituted suspension. This aligns with the findings of Hu et al. in the uneducated group (38). In the study conducted by Al-Ramahi et al., 56.5 % of caregivers stored reconstituted suspensions in the refrigerator (31). Our study identified that 43.4 % of caregivers held misconceptions regarding the shelf life of antibiotic suspensions. This finding aligns with Olorukooba et al., where over 60 % of caregivers did not keep reconstituted suspensions in the refrigerator (32). Reconstituted dry powder suspensions typically remain stable in the refrigerator for a specified period, usually seven to ten days (39). Misunderstanding shelf life can lead to the use of expired medication, potentially reducing its effectiveness (40).

It is encouraging to note that a high percentage of caregivers (67.3 %) reported reading medication instructions and understanding the information provided. This aligns with the findings of Qu et al., where more than 90 % of parents believed that reading instructions carefully before using antibiotics was necessary (41). Both pharmacists and doctors provided guidance (55.4 % and 44.6 %, respectively), but it is essential to encourage patients to actively seek and comprehend information from both leaflets and healthcare professionals for optimal medication management. These findings are consistent with Al-Ramahi et al., where 86.8 % of mothers reported reading instructions, with pharmacists and doctors being the primary sources of advice (31). Aika et al. also found that caregivers were open to education on antibiotic use, resulting in a significant improvement in knowledge and practices after an educational session (26). Similarly, Tadesse et al. reported that 54.3 % of patients were satisfied with pharmacy services (42). These findings are contrasted by a study conducted by Machongo et al. at Zomba Central Hospital in Malawi, who found that caregivers often have limited knowledge about antibiotic use and resistance (21). This lack of knowledge leads to inappropriate practices such as self-medication, using leftover antibiotics, and buying antibiotics without a prescription. Public awareness, community-led interventions, and targeted education are crucial for educating caregivers about medication management, requiring collaboration between pharmacists and physicians (43).

The findings indicated a concerning diversity in dosing

tool selection. Syringes were the most commonly used tool, followed by medicinal spoons and household teaspoons. The preference for syringes somewhat aligns with findings from other studies where syringes were the most common device used in children aged 1 to 5 years old (44–46). However, a significant number of caregivers in our study also reported using alternative methods like medicinal spoons, household teaspoons, and household cups. This is inconsistent with recommendations that stress the use of calibrated syringes for accurate dosing, particularly for medications like antibiotics where precise measurement is crucial (47). Educational interventions should stress the importance of accurate dosing devices, especially for younger children, and caregivers should use the provided dosing tool to prevent errors (48).

A positive finding of this study was that 96.5 % of caregivers practiced good hygiene when using dosing tools. This aligns with the emphasis on handwashing and proper cleaning procedures highlighted in medication safety guidelines set by organizations like the WHO (49). Similar high rates of hygiene practices were reported in a study by Wana et al., who found that the majority of caregivers followed proper handwashing procedures before administering medication to children (50). This consistency highlights the potential effectiveness of educational interventions that emphasize hygiene practices alongside medication administration techniques (51).

The study identified positive trends in caregiver satisfaction with pharmacist counseling. Caregivers reported significantly higher satisfaction scores for both the time spent discussing medications and the adequacy of counseling, with high percentages of caregivers receiving counseling on crucial topics like side effects, administration frequency, and reconstitution techniques. The effectiveness of pharmacist counseling in promoting proper medication administration was highlighted. These results are consistent with findings from similar studies. For example, a study at Woldia Comprehensive Specialized Hospital revealed that patients who received comprehensive counseling from pharmacists exhibited significantly higher satisfaction levels (42). Furthermore, a study by Lock et al. on the effects of pharmacist-led counseling on pediatric antibiotic suspension reconstitution among rural parents highlighted that the adequacy of counseling was a significant predictor of correct antibiotic use (52). Another study by Hu et al. demonstrated significant improvements in caregivers' knowledge of antibiotic use following educational interventions, particularly emphasizing the effectiveness of one-on-one education over group sessions (38).

LIMITATIONS

This study provides valuable insights into caregiver knowledge and practices regarding antibiotic suspensions in Beirut, Lebanon. However, it is important to acknowledge some limitations. The participants were recruited through convenience sampling at pharmacies, which may have introduced selection bias. Additionally, the findings are specific to Beirut and may not be generalizable to other regions with different healthcare systems, cultural practices, or socioeconomic disparities. Furthermore, relying solely on self-reported practices through questionnaires may lead to recall bias. Participants might not accurately remember specific actions or may tend to underreport certain behaviors. Finally, the study did not comprehensively explore certain factors that could influence caregiver knowledge and practices, such as access to healthcare professionals or preferred sources of information on medication use. Despite these limitations, the study's adequate sample size and focused methodology enhance its statistical power and value for future research and intervention development.

CONCLUSION

This study conducted in Beirut, Lebanon, found that caregivers generally understood medication instructions and followed prescribed dosages. However, they often deviated from recommended practices, such as using cold

mineral water for reconstitution and not following proper techniques. Storage practices also did not meet optimal recommendations. To minimize antibiotic resistance, a comprehensive approach is recommended, including educational campaigns, strengthening pharmacist training, and incorporating visuals into medication leaflets. These interventions can promote responsible antibiotic use among caregivers, improving health outcomes and mitigating the global threat of antibiotic resistance.

CONFLICTS OF INTERESTS

The authors declare that there are no conflicts of interest.

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ETHICAL CONSIDERATIONS

Ethical clearance for this study was obtained from the LIU University research committee.

REFERENCES

1. Walsh TR, Gales AC, Laxminarayan R, Dodd PC. Antimicrobial Resistance: Addressing a Global Threat to Humanity. *PLoS Med*. 2023 Jul; 20(7): e1004264.
2. Padiyara P, Inoue H, Sprenger M. Global Governance Mechanisms to Address Antimicrobial Resistance. *Infect Dis* (Auckl). 2018; 11: 117863371876788. Available from: http://journals.sagepub.com/doi/10.1177/1178633718767887
3. Singh P, Holmen J. Multidrug-Resistant Infections in the Developing World. *Pediatric Clinics of North America*. 2022; 69(1): 141–52. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0031395521001450
4. Collineau L, Bourély C, Rousset L, Berger-Carbonne A, Ploy MC, Pulcini C, et al. Towards One Health surveillance of antibiotic resistance: characterisation and mapping of existing programmes in humans, animals, food and the environment in France, 2021. *Eurosurveillance*. 2023; 28(22). Available from: https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2023.28.22.2200804
5. Knobloch MJ, McKinley L, Keating J, Safdar N. Integrating antibiotic stewardship and infection prevention and control programs using a team science approach. *American Journal of Infection Control*. 2021; 49(8): 1072–4. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0196655321000547
6. Xavier SP, Victor A, Cumaquela G, Vasco MD, Rodrigues O, Cobre ADF. Inappropriate Use of Antibiotics and Their Predictors in Pediatric Patients Admitted at the Hospital Central De Nampula, Mozambique. *Antimicrob Resist Infect Control*. 2022; 11(1): 79-86. Available from: https://doi.org/10.1186/s13756-022-01115-w
7. Kakati R, Nakad Borrego S, Zareef R, Atallah J, Farhat S, Daye N, et al. Dispensing and Purchasing Antibiotics Without Prescription: A Cross-sectional Study Among Pharmacists and Patients in Beirut, Lebanon. *INQUIRY*. 2023; 60: 004695802311677. Available from: http://journals.sagepub.com/doi/10.1177/00469580231167712
8. Perruccio K, Rosaria D'Amico M, Baretta V, Onofrillo D, Carraro F, Calore E, et al. Ceftolozane/Tazobactam and Ceftazidime/Avibactam: An Italian Multi-center Retrospective Analysis of Safety and Efficacy in Children With Hematologic Malignancies and Multi-drug Resistant Gram-negative Bacteria Infections. *Pediatric Infectious Disease Journal*. 2022; 41(12): 994–6. Available from: https://journals.lww.com/10.1097/INF.0000000000003716

9. Diaz A, Antonara S, Barton T. Prevention Strategies to Combat Antimicrobial Resistance in Children in Resource-Limited Settings. *Curr Trop Med Rep*. 2018; 5(1): 5–15. Available from: http://link.springer.com/10.1007/s40475-018-0136-8
10. Willems J, Hermans E, Schelstraete P, Depuydt P, De Cock P. Optimizing the Use of Antibiotic Agents in the Pediatric Intensive Care Unit: A Narrative Review. *Pediatr Drugs*. 2021; 23(1): 39–53. Available from: http://link.springer.com/10.1007/s40272-020-00426-y
11. Ayyash M, Abu-Farha R, Jaber K, Ateih S, Akour A. Patterns of Antibiotic Use, Knowledge, and Perceptions among Jordanian Population: A Cross-sectional Study. *Jordan j pharm sci*. 2024; 17(1): 131–43. Available from: https://jjournals.ju.edu.jo/index.php/jjps/article/view/1744
12. Sonji NM, Sonji GM. Fostering Healthier Choices: Empowering Pharmacy Students to Bridge the Food Label Gap in Lebanon. *Jordan j pharm sci*. 2024; 17(3): 582–93. Available from: https://jjournals.ju.edu.jo/index.php/jjps/article/view/2290
13. Mina S, Azakir B. HEALTHCARE WORKERS PERCEPTIONS REGARDING ANTIBIOTIC USE DURING COVID-19 PANDEMIC IN LEBANON: A CROSS-SECTIONAL STUDY. *HWB*. 2022; 4(2). Available from: http://digitalcommons.bau.edu.lb/hwbjournal/vol4/iss2/10
14. Henaine AM, Lahoud N, Abdo R, Shdeed R, Safwan J, Akel M, et al. Knowledge Towards Antibiotics Use Among Lebanese Adults: A study on the influence of sociodemographic factors. *Sultan Qaboos Univ Med J*. 2021; 21(3): 442–9. Available from: https://journals.squ.edu.om/index.php/squmj/article/view/4180
15. Mallah N, Badro DA, Figueiras A, Takkouche B. Association of knowledge and beliefs with the misuse of antibiotics in parents: A study in Beirut (Lebanon). Perez SF, editor. *PLoS ONE*. 2020; 15(7): e0232464. Available from: https://dx.plos.org/10.1371/journal.pone.0232464
16. Dantuluri KL, Bonnet KR, Schlundt DG, Schulte RJ, Griffith HG, Luu A, et al. Antibiotic perceptions, adherence, and disposal practices among parents of pediatric patients. Shankar PR, editor. *PLoS ONE*. 2023; 18(2): e0281660. Available from: https://dx.plos.org/10.1371/journal.pone.0281660
17. Bezuidenhout W, Cummings J, De Klerk L, Finlay D, Lewis C, Pienaar L, et al. The knowledge and practices of caregivers regarding the administration of oral liquid medication to children at a healthcare clinic in Bloemfontein, South Africa. *S Afr J Child Health*. 2022; 166–71. Available from: https://samajournals.co.za/index.php/sajch/article/view/290
18. Hejaz HA. Knowledge and Attitudes towards Antibiotic Usage. *Jordan j pharm sci*. 2023; 16(2): 447. Available from: https://jjournals.ju.edu.jo/index.php/jjps/article/view/1486
19. Patel S, Kolte S, Magdalia H, Bhatt S, Patel R. Liquid Medication Dosing Error amongst Parents Caregivers at Outpatient Clinic. *IJOPP*. 2022; 15(3): 235–43. Available from: https://ijopp.org/article/960
20. Titami A, Mende J, Nurfina Dian K. Drug-related problems of antibiotic therapy used for pediatric: Article review. *IJPTher*. 2022; 3(2). Available from: https://jurnal.ugm.ac.id/v3/JPT/article/view/2692
21. Machongo RB, Nyondo-Mipando AL. "I don't hesitate to use the left-over antibiotics or if I don't have any, I rush to my neighbours to ask for an antibiotic for my child." Practices and experiences with antibiotic use among caregivers of paediatric patients at Zomba Central Hospital in Malawi. *BMC Pediatr*. 2022; 22: 466. Available from: 10.1186/s12887-022-03528-3
22. Stanley C, Igala S. Effect of Different Storage Conditions on the Stability and Efficacy of Some Reconstituted Oral Antibiotic Suspensions Sold in Port Harcourt, Nigeria. *JPRI*. 2018; 20(3): 1–10. Available from: https://journaljpri.com/index.php/JPRI/article/view/100

23. Aricò MO, Valletta E, Caselli D. Appropriate Use of Antibiotic and Principles of Antimicrobial Stewardship in Children. *Children*. 2023; 10(4): 740. Available from: https://www.mdpi.com/2227-9067/10/4/740
24. Bert F, Previti C, Calabrese F, Scaioli G, Siliquini R. Antibiotics Self Medication among Children: A Systematic Review. *Antibiotics*. 2022; 11(11): 1583. Available from: https://www.mdpi.com/2079-6382/11/11/1583
25. Olmeda K, Trautner BW, Laytner L, Salinas J, Marton S, Grigoryan L. Prevalence and Predictors of Using Antibiotics without a Prescription in a Pediatric Population in the United States. *Antibiotics*. 2023; 12(3): 491. Available from: https://www.mdpi.com/2079-6382/12/3/491
26. Aika IN, Enato E. Bridging the gap in knowledge and use of antibiotics among pediatric caregivers: comparing two educational interventions. *J of Pharm Policy and Pract*. 2023; 16(1): 76. Available from: https://joppp.biomedcentral.com/articles/10.1186/s40545-023-00578-5
27. Salam MdA, Al-Amin MdY, Salam MT, Pawar JS, Akhter N, Rabaan AA, et al. Antimicrobial Resistance: A Growing Serious Threat for Global Public Health. *Healthcare*. 2023; 11(13): 1946. Available from: https://www.mdpi.com/2227-9032/11/13/1946
28. Kumarasinghe M, Weerasinghe MC. Reconstitution of oral antibiotic suspensions for paediatric use in households: a cross-sectional study among caregivers of 3–5-year-old children from a selected district, Sri Lanka. *BMC Pediatr*. 2024; 24(1): 241. Available from: https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-024-04725-y
29. Parihar N, Jha T, Parihar S. Assessment of Administration Practice of Dry Powder Antibiotic Suspension Among Caregivers Who Visits Rural Community Pharmacy. *Paripex - Indian Journal of Research*. 2021; 10(6): 17–9.
30. Neves I, Auxtero MD. Dosing Accuracy of Oral Extemporaneous Suspensions of Antibiotics: Measuring Procedures and Administration Devices. *Pharmaceutics*. 2021; 13(4): 528. Available from: https://www.mdpi.com/1999-4923/13/4/528
31. Al-Ramahi RJ, Zaid AAN, Anabousi H. Problems associated with reconstitution, administration, and storage of antibiotic suspensions for pediatrics: a cross-sectional study in Nablus city, Palestine. *BMC Res Notes*. 2015; 8(1): 760. Available from: http://www.biomedcentral.com/1756-0500/8/760
32. Olorukooba AB, Abdu-Aguye SN, Olorukooba AA, Iniaghe LO. Pediatric suspension usage & reconstitution practices of mothers in Zaria, northwestern Nigeria. 2019; 15(1): 107–14.
33. Abouleish MY. Water quality and usage for reconstitution of antibiotics. 8th International Conference and Exhibition on Pharmaceutics & Novel Drug Delivery Systems March 07-09, 2016 Madrid, Spain. 2016; 7(1).
34. Lugli GA, Longhi G, Mancabelli L, Alessandri G, Tarracchini C, Fontana F, et al. Tap water as a natural vehicle for microorganisms shaping the human gut microbiome. *Environmental Microbiology*. 2022; 24(9): 3912–23. Available from: https://sfamjournals.onlinelibrary.wiley.com/doi/10.1111/1462-2920.15988
35. Kotb S, Ahmed M, Hassan D, Soltan E. Stability of antibiotics in drinking water: An advanced approach towards the impacts of water quality parameters on doxycycline bioavailability. *J Adv Vet Anim Res*. 2019; 6(4): 438. Available from: https://www.ejmanager.com/fulltextpdf.php?mno=59922
36. Alsabra T, Farajat M, Alyazjeen A, Njadat S, Haddadin S, Alnoime F, et al. Knowledge and awareness of proper use of antibiotics for children in Shobak medical center in Jordan. *Zagazig J Pharm Sci*. 2015; 24(1): 19–24.

37. Tejedor Tejada E, Gómez Pérez B, Soy Muner D. Review of Drug Storage Conditions, A Case Report. *Hosp Pharm*. 2023; 58(3): 252–4. Available from: http://journals.sagepub.com/doi/10.1177/00185787221134696
38. Hu H, Wu FLL, Hu FC, Yang HY, Lin SW, Shen LJ. Effectiveness of Education Programs About Oral Antibiotic Suspensions in Pediatric Outpatient Services. *Pediatrics & Neonatology*. 2013; 54(1): 34–42. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1875957212001635
39. Bhandare PS, Yadav AV. A Review on "Dry Syrups For Paediatrics." *International Journal of Current Pharmaceutical Research*. 2017; 9(1): 25–31.
40. Schwenke J, Stroup W, Quinlan M, Forenzo P. Estimating Shelf Life Through Tolerance Intervals Extended to Nonlinear Response Trends. *AAPS PharmSciTech*. 2023; 24(4): 80. Available from: https://link.springer.com/10.1208/s12249-023-02532-9
41. Qu W, Wang X, Liu Y, Mao J, Liu M, Zhong Y, et al. Self-Medication with Antibiotics Among Children in China: A Cross-Sectional Study of Parents' Knowledge, Attitudes, and Practices. *IDR*. 2023; 16: 7683–94. Available from: https://www.dovepress.com/self-medication-with-antibiotics-among-children-in-china-a-cross-secti-peer-reviewed-fulltext-article-IDR
42. Tadesse YB, Sendekie AK, Mekonnen BA, Denberu FG, Kassaw AT. Pharmacists' Medication Counseling Practices and Knowledge and Satisfaction of Patients With an Outpatient Hospital Pharmacy Service. *INQUIRY*. 2023; 60: 00469580231219457. Available from: http://journals.sagepub.com/doi/10.1177/00469580231219457
43. Bongard A, Strub B, Berger J, Gouveia A. Optimiser l'adhésion médicamenteuse en ambulatoire. Interconnexion entre patients, infirmiers à domicile, pharmaciens et médecins. *Revue Médicale Suisse*. 2022; 18(803): 2090–5. Available from: https://www.revmed.ch/revue-medicale-suisse/2022/revue-medicale-suisse-803/optimiser-l-adhesion-medicamenteuse-en-ambulatoire.-interconnexion-entre-patients-infirmiers-a-domicile-pharmaciens-et-medecins
44. Saito J, Nakamura H, Walsh J, Yamatani A, Salunke S. A Survey to Understand Parent/Caregiver and Children's Views on Devices Used for the Administration of Oral Pediatric Medicines in Japan. *Children*. 2022; 9(2): 196. Available from: https://www.mdpi.com/2227-9067/9/2/196
45. Williams TA, Wolf MS, Parker RM, Sanders LM, Bailey S, Mendelsohn AL, et al. Parent Dosing Tool Use, Beliefs, and Access: A Health Literacy Perspective. *The Journal of Pediatrics*. 2019; 215: 244-251.e1. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0022347619310017
46. Tordoff J, Naidu R, Bassett-Clarke D, Nicholson R. Parents and caregivers experience in managing children's medicines after discharge from a New Zealand hospital. *NZMJ*. 2022; 135(1559): 8–23. Available from: https://nzmj.org.nz/journal/vol-135-no-1559/parents-and-caregivers-experience-in-managing-childrens-medicines-after-discharge-from-a-new-zealand-hospital
47. Yin HS, Parker RM, Sanders LM, Dreyer BP, Mendelsohn AL, Bailey S, et al. Liquid Medication Errors and Dosing Tools: A Randomized Controlled Experiment. *Pediatrics*. 2016; 138(4): e20160357. Available from: https://publications.aap.org/pediatrics/article/138/4/e20160357/52278/Liquid-Medication-Errors-and-Dosing-Tools-A
48. Yin HS, Neuspiel DR, Paul IM, Franklin W, Tieder JS, Adirim T, et al. Preventing Home Medication Administration Errors. *Pediatrics*. 2021; 148(6): e2021054666. Available from: https://publications.aap.org/pediatrics/article/148/6/e2021054666/183379/Preventing-Home-Medication-Administration-Errors

49. World Health Organization, WHO Patient Safety. WHO guidelines on hand hygiene in health care. 2009; (WHO/IER/PSP/2009/01): 262. Available from: https://iris.who.int/handle/10665/44102
50. Wana EW, Mengesha NA. Hand washing at critical times and associated factors among mothers/caregivers of under-five children in Nefas Silk Lafto Sub-City, Addis Ababa, Ethiopia, 2019: Facility based cross-sectional study. 2022. Available from: http://medrxiv.org/lookup/doi/10.1101/2022.06.24.22276847
51. Lange S, Barnard TG, Naicker N. The effect of a hand hygiene intervention on the behaviour, practices and health of parents of preschool children in South Africa. *Perspect Public Health*. 2022; 142(6): 338–46. Available from: http://journals.sagepub.com/doi/10.1177/17579139221123404
52. Lock BX, Chong CP. Effects of pharmacist-led counseling on pediatric antibiotic suspension reconstitution knowledge and technique among rural parents: A multicenter study in Malaysia. *J Appl Pharm Sci*. 2024; Available from: https://japsonline.com/abstract.php?article_id=4268&sts=2

آراء وممارسات مقدمي الرعاية فيما يتعلق بمعلقات المضادات الحيوية للأطفال في لبنان

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ملخص

يواجه لبنان التحدي الملح المتمثل في إساءة استخدام المضادات الحيوية للأطفال. ولمعالجة هذه المشكلة، أجرينا دراسة مقطعية في بيروت تهدف إلى تقييم معرفة وممارسات مقدمي الرعاية فيما يتعلق بمعلقات المضادات الحيوية لدى الأطفال. تمت مقابلة ما مجموعه 113 من مقدمي الرعاية في الصيدليات لتقييم فهمهم لتعليمات الدواء، ودقة الجرعات، وممارسات التخزين/التخلص، والرضا عن استشارات الصيدلي. أشارت النتائج إلى أنه في حين أظهر 67.3% من مقدمي الرعاية فهمًا واضحًا لتعليمات الدواء واتبع 63.7% إعادة التركيب السليم، فقد ظهرت ممارسات مقلقة. والجدير بالذكر أن 71.7% من مقدمي الرعاية قاموا بتخزين بقايا المعلقات في المطابخ. ومع ذلك، فإن 56.6% تخلصوا منها بشكل صحيح. إن الاستخدام الواسع النطاق للمياه المعدنية الباردة كمخفف (66.4٪) يتناقض مع المبادئ التوجيهية. لعب الصيادلة دورًا حاسمًا، حيث تلقى 69.1% من مقدمي الرعاية الاستشارة، ولكن متوسطها 3.7 دقيقة فقط، مما يشير إلى وجود مجال للتحسين. وقد ظهرت ارتباطات مهمة بين الفهم الدقيق وإعادة التكوين السليم ($p < 0.001$). وتسلط هذه النتائج الضوء على الحاجة إلى تعليمات أكثر وضوحا لمقدمي الرعاية، ومبادرات تعليمية بشأن التخزين والتخلص المناسبين، وتعزيز التدريب للصيادلة. إن معالجة هذه الجوانب يمكن أن تحسن النتائج الصحية في لبنان وتساهم في المعركة العالمية ضد مقاومة المضادات الحيوية.

الكلمات الدالة: استخدام معلق المضادات الحيوية؛ مقدمو الرعاية؛ المعرفة والممارسات؛ إدارة الأدوية؛ التحسين؛ الاستشارة الصيدلانية.

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