Original Paper

Mobile Technology Engagement Among Caregivers and Its Implications for Childhood Antibiotic Stewardship in Northern Vietnam: Mixed Methods Community-Based Study

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Abstract

Background: In Vietnam, antibiotic use without involvement of health care professionals is common in the community, despite the legal requirement for a prescription. In low- and middle-income countries, mobile health (mHealth) is perceived as having the potential to improve community health care at low cost.

Objective: In this study, we aimed to explore the relationship between mobile phone ownership and health-seeking behaviors among caregivers of children aged 5 years or younger to inform the design of an mHealth intervention to improve antibiotic use practices in the community.

Methods: A convergent mixed methods approach combined a cross-sectional household survey and in-depth interviews (IDIs). We surveyed 450 households with children aged 5 years or younger and interviewed caregivers about their health-seeking behaviors and how they engage with mobile technology to inform their health care decisions and antibiotic use. Qualitative data were collected through IDIs and focus group discussions (FGDs) with a purposive sample of household survey respondents. Data collection was conducted between June and September 2023 at 2 sites: 1 urban and 1 rural area in a northern province of Vietnam. Factors associated with using mobile phones to seek health care information were identified through multivariable logistic regression and thematic analysis. Quantitative and qualitative findings were then integrated to provide contextual insights.

Results: For the quantitative household survey, 450 of 460 approached households completed the survey. For the qualitative component, 38 of 60 approached caregivers participated in 4 FGDs and 6 IDIs. Almost all households had an internet connection (444/450, 98.7%, 95% CI 97.1%-99.4%). While 80.2% (308/384, 95% CI 75.9%-83.9%) of caregivers used mobile devices to access child health care information, only 27.1% (29/107, 95% CI 19.6%-36.2%) reported using the internet to obtain antibiotic-related information. Older caregivers (adjusted odds ratio [aOR] 0.65, 95% CI 0.43-0.99) and caregivers living in the urban area (aOR 0.45, 95% CI 0.24-0.85) were less likely to seek health-related information online using mobile devices than younger or rural caregivers, respectively. In contrast, a higher level of caregiver education was significantly associated with more favorable engagement in online health information–seeking behavior (aOR 2.73, 95% CI 1.61-4.61). Caregivers demonstrated highly active and intentional online information-seeking behaviors, driven by a strong desire to enhance their knowledge and confidence in making childcare and treatment decisions. Qualitative findings highlighted a need for trustworthy, professionally supported digital health platforms tailored to child health and antibiotic use.

Conclusions: This study highlights caregivers' health care information–seeking behaviors and engagement with digital technologies for antibiotic-related information, demonstrating the potential of mobile phones to support antibiotic-related

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decision-making and improve antibiotic use practices. These findings provide insights to inform the design of context-appropriate mHealth interventions to support caregivers in making decisions about antibiotic use.

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KEYWORDS

antibiotic stewardship; caregiver; children aged 5 years; community; low- and middle-income countries; LMICs; mHealth; mobile health

Introduction

Antimicrobial resistance (AMR) is a major global public health challenge with substantial health, social, and economic consequences [1]. Evidence from the literature indicates that antibiotic misuse, overuse, and suboptimal dosing contribute to AMR, underscoring the importance of antimicrobial stewardship [2]. Vietnam's high levels of AMR are driven by high rates of antibiotic use and widespread access to antibiotics outside formal health care systems [3-5]. Children aged 5 years or younger are the age group with the highest antibiotic use in Vietnam. A nationally representative household survey conducted in 2014 reported that 83% of children aged 5 years or younger with a cough received antibiotics in the preceding year, with most antibiotics obtained from non–health care settings, particularly community pharmacies [6]. Almost half of children were reported to have a cough or other respiratory symptoms during the 2-week period before the survey, and 40% were given antibiotics during that period. Similarly, a study of 193,010 outpatient visits for acute respiratory infections (ARIs) in Nam Dinh Province in 2019 found that 97% resulted in an antibiotic prescription [7]. Notably, 18.1% of prescriptions for children aged 5 years or younger were classified as "Watch" antibiotics, which have a higher potential to promote AMR. More broadly, a multicountry study conducted in 6 low- and middle-income countries (LMICs), including Vietnam, found that antibiotic use was generally excessive rather than restricted, particularly in Asian settings, where high densities of antibiotic suppliers facilitated widespread availability [5].

Caregivers play a central role in decisions regarding health care seeking, antibiotic acquisition, and antibiotic administration for young children, making them important targets for community-based antibiotic stewardship interventions. Studies from Vietnam and other countries across 6 continents have shown that caregivers frequently influence whether antibiotics are sought, purchased, used without a prescription, or requested from health care providers [8-11]. Understanding caregivers' health information needs, health-seeking behaviors, and access to communication technologies is therefore an important prerequisite for designing effective interventions. Mobile health (mHealth) technologies may provide a promising platform for delivering antibiotic stewardship interventions to caregivers. The rapid expansion of mobile phone ownership in LMICs has created new opportunities to provide health information and behavior-change interventions at relatively low cost [12-15]. In Vietnam, mobile phone adoption is widespread across both urban and rural areas. In 2022, there were 137.4 million mobile phone subscriptions, exceeding the national population of approximately 99.5 million (General Statistics Office of Vietnam). Although interest in mHealth interventions has increased substantially over the past decade, the evidence base has been dominated by interventions targeting chronic noncommunicable diseases, particularly diabetes, cardiovascular disease, hypertension, and other long-term conditions. Many studies have been conducted in clinical or hospital settings, and a substantial proportion of interventions have been designed to support health care providers rather than end users or caregivers [16-20]. Moreover, evidence on the feasibility and acceptability of using mobile technologies to support informed antibiotic use in community settings remains limited [21].

To inform the development of digital interventions that support informed antibiotic use decisions for young children, it is important to understand caregivers' access to and use of mobile technologies, their health information–seeking behaviors, and their willingness to engage with mHealth services. Therefore, this study aimed to examine caregivers' health-seeking and antibiotic use behaviors and their engagement with mobile technologies for child health information, with a focus on informing the design of mHealth interventions to support antibiotic use decisions.

Methods

Study Design and Settings

This study used a convergent mixed methods design, in which quantitative and qualitative data were collected concurrently, analyzed separately, and integrated through comparison during interpretation to provide a comprehensive understanding of caregivers' health care–seeking behaviors and the potential for mHealth-based interventions to support informed antibiotic use. While the household survey quantified patterns of mobile phone ownership, health care access, and antibiotic use, phone ownership alone is a crude measure of mobile technology use and does not capture who uses the phone or how it is used in practice. To complement the survey findings and provide contextual insights, qualitative data were collected through in-depth interviews (IDIs) and focus group discussions (FGDs).

The study was conducted in an urban (district town) and a rural commune in Vu Ban District, Nam Dinh Province, Vietnam. This province is approximately 90 km from Hanoi, the capital city. The selected urban commune had a population of 6339 people, while the rural commune had a population of 4100 people.

Sample Size Calculation

At the time of study design, no published data were available on the prevalence of caregivers in northern Vietnam using mobile devices to seek health-related information for their

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children. While national statistics show high rates of smartphone ownership and internet use among the general adult population, these indicators do not directly reflect caregiver health information–seeking behavior. In the absence of more relevant local data, a conservative prevalence estimate of 15% was used for the sample size calculation to ensure adequate precision. Based on this assumption, a sample of 196 participants was required to estimate this proportion with a 5% margin of error at a 95% confidence level. We recruited 225 households with children aged 5 years or younger at each site, allowing for 15% dropout or refusal. The number of FGDs (n=4) and IDIs (n=6) was predetermined based on the study objectives and sampling strategy.

Sampling and Participant Recruitment

In the quantitative component, surveys were conducted among 225 households with children aged 5 years or younger at each of the 2 sites, yielding a total of 450 households. The selected commune health centers (CHCs) provided sampling frames consisting of households with at least 1 child aged 5 years or younger, comprising 316 households in the rural commune and 258 households in the urban commune. Field workers used these sampling frames to identify households according to their residence cluster (hamlet/village) and approached households to invite them to participate in the study. Recruitment continued across the residence clusters until the required sample size was reached. Following the survey, 4 FGDs (with 8 participants each) and 6 individual IDIs were conducted to provide further context and depth to the preliminary insights and hypotheses. Participants were selected from the survey respondents using purposive sampling to ensure diversity in age, socioeconomic status, geographic location (urban/rural), and caregiving experience. They were recruited by CHC staff through face-to-face or telephone contact, based on their availability and willingness to share their caregiving experience. Participants were assigned to IDIs or FGDs based on their willingness and preference for sharing their experiences in a group setting. Each session was conducted by 1 researcher with a note-taker (PBB). Both researchers (NTTD and HNTC) had prior experience in qualitative moderation. During FGDs, the moderator facilitated balanced group dynamics by encouraging less active participants to contribute and preventing dominance by more active participants. Participants aged 18 years or older who were responsible for health care decisions for the child, particularly regarding illness management, treatment-seeking, and medication use, and who consented to participate were eligible for both quantitative and qualitative components.

Data Collection Procedures

Data were collected from June to September 2023. Household data were collected by trained field workers using tablets and a web-based application (REDCap). A questionnaire (Multimedia Appendix 1) was developed and adapted from previous studies examining the use of mHealth for health care [22-24]. The questionnaire covered the following domains: (1) sociodemographic characteristics; (2) childhood illness management practices; and (3) health care–seeking behavior, including the use of mobile devices to inform health care decisions and antibiotic use, as well as the types of information accessed and trusted. The use of mobile devices for seeking health care information was categorized as a binary outcome ("yes" if mobile devices were sometimes or often used and "no" if they were never used). Respondents were also asked to rate their level of agreement on a 5-point Likert scale (strongly agree to strongly disagree) with statements relating to their knowledge and awareness of antibiotics and antibiotic resistance. The questionnaire was pretested with 2 caregivers of children aged 5 years or younger who were not involved in the study and had no relevant background or prior knowledge of the study topic. The pretesting assessed the clarity, comprehensibility, and appropriateness of the questions in the local language. Minor wording changes were made based on their feedback. The pretesting was conducted solely for instrument refinement, and the pretest responses were not included in the final analysis.

Focus group discussions were conducted face-to-face at CHCs using a semistructured discussion guide (Multimedia Appendix 2) and flexible facilitation. In-depth interviews (IDIs) were conducted one-to-one in private rooms at CHCs using a semistructured interview guide with open-ended questions (Multimedia Appendix 2). Interviews were conducted by NTTD (PhD) and HNTC (master of international relations), both female researchers. NTTD was a postdoctoral researcher, and HNTC was a research assistant at the time of the study. Both researchers had prior training and experience in conducting qualitative research and qualitative data analysis. The interviewers had no prior relationship with the participants before the commencement of the study. Participants were informed about the researchers' roles and the purpose of the study before the interviews. The interviews focused on participants' perspectives and experiences regarding their knowledge and practices related to antibiotic use and health care–seeking for children, as well as their expectations regarding health care information and support. The interview guide also included questions about participants' ownership and use of mobile devices and internet-based resources to seek health care information for their children. The interview guide was piloted with two local staff members without relevant background or prior knowledge of the study topic to assess the clarity and appropriateness of the questions in the local language. Minor wording changes were made based on their feedback. The pilot interviews were conducted solely for pretesting and were not included in the final analysis. The individual IDIs lasted approximately 45 minutes, while the FGDs lasted between 1.5 and 2 hours. Field notes were taken during the IDIs and FGDs to document key observations, contextual information, and nonverbal cues.

To ensure consistent understanding, trained interviewers administered the questionnaire using standardized wording and, when needed, provided commonly used local antibiotic names and examples to clarify that the questions referred specifically to antibiotics rather than other medicines.

Terminology Definitions

In this study, a mobile phone refers to any cellular telephone, including basic phones and smartphones. A smartphone refers to a mobile phone with advanced computing and internet-enabled functions. The term "mobile device" is used more broadly to encompass mobile phones, smartphones, and

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other portable digital devices. mHealth refers to the use of mobile devices and wireless technologies to support health-related activities, information, communication, or services.

Data Analysis

The analysis and presentation of the quantitative data followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting observational studies (Multimedia Appendix 3) [25]. Descriptive data were summarized as proportions or medians and IQRs, as appropriate. Proportions were calculated as percentages, and 95% CIs were estimated using the Wilson score method. Children's characteristics from the household survey were also summarized. Symptom categories were not mutually exclusive. Binary logistic regression was used to identify factors associated with the primary outcome, defined as the use of mobile devices for health care seeking. The multivariable logistic regression model included 8 variables: age, gender, religion, income, education, area of residence, social media use, and ownership of a smartphone, tablet, or other smart mobile devices. These variables were included because of their potential relevance as sociodemographic and technology-related factors associated with mHealth care seeking. Participants with missing data were excluded from the multivariable analysis. Multicollinearity among the included variables was assessed using variance inflation factors (VIFs). The Hosmer-Lemeshow goodness-of-fit test was used to assess model fit. Crude and adjusted odds ratios (ORs) with 95% CIs were reported.

The qualitative interviews and discussions were audio-recorded and transcribed verbatim. The transcripts from both FGDs and IDIs were subsequently analyzed together using thematic analysis by HNTC [26]. Initial codes were generated from the transcripts and reviewed and grouped according to similarities and differences in meaning. Related codes were organized into subthemes and broader themes, which were reviewed and refined to ensure that they accurately represented the data. The coding tree followed a hierarchical structure, with specific codes representing participants' accounts at the initial level, which were subsequently clustered into conceptually related subthemes and then synthesized into broader overarching themes. The coding structure was reviewed and discussed iteratively by HNTC, NTTD, and SOL against the transcripts to ensure that the themes and subthemes remained grounded in participants' accounts and were conceptually distinct and coherent. Data saturation was assessed during analysis by examining whether later sessions generated new themes or perspectives to determine whether sufficient thematic coverage had been achieved. NTTD and SOL contributed to the interpretation and refinement of the qualitative findings based on their experience in qualitative research. For the mixed methods integration, NTTD and SOL reviewed the quantitative and qualitative findings together to identify areas of convergence, complementarity, and divergence. They jointly contributed to the interpretation and integration of the 2 data strands, with a joint display matrix used to facilitate systematic comparison and synthesis of the findings. NVivo (version 12.0; QSR International) was used to organize, code, retrieve, and manage the qualitative data. Illustrative quotations were selected to support the interpretation and presentation of the final themes and subthemes. The analysis and presentation of qualitative data followed the COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines for reporting qualitative research (Multimedia Appendix 4) [27].

Integration of Quantitative and Qualitative Data

Integration of the quantitative and qualitative components was conducted at the interpretation stage. Quantitative findings provided an overview of patterns and associations related to caregivers' health care–seeking behaviors, mobile phone access, and antibiotic use, while qualitative findings were used to explain, contextualize, and expand upon these results. Following separate analyses of each dataset, the findings were compared to identify areas of convergence, complementarity, and divergence. A joint display matrix was developed to align key quantitative findings with corresponding qualitative themes, facilitating systematic comparison and interpretation. Where findings converged, qualitative data were used to provide explanatory insights into the observed quantitative patterns. Where discrepancies occurred, these were examined to identify potential contextual or methodological explanations. The integrated interpretation informed the overall conclusions by synthesizing evidence from both methodological strands, thereby providing a deeper understanding of caregivers' experiences, decision-making processes, perceptions of mHealth, and the contextual factors shaping health care–seeking and antibiotic use.

Ethical Considerations

The protocol was approved by the Oxford University Tropical Research Ethics Committee (OxTREC reference number 504-22) and the Ethics Committee of Hanoi University of Public Health (HUPH), Vietnam (reference number 1399/GCN-HDDD). Permission to conduct the study was also obtained from local authorities.

At the first point of contact, interviewers provided participants with information about the study objectives, procedures, potential risks and benefits, and other relevant details. Written informed consent was obtained from all participants before data collection commenced. All participant data were anonymized to ensure confidentiality. Participants in the household survey received an amount equivalent to US $5 as compensation for their time, while those participating in IDIs or FGDs received an amount equivalent to US $10.

Results

Overview

Reflecting the convergent mixed methods approach, the Results section progresses from the quantitative findings to the qualitative findings and concludes with an integrated presentation of findings from both data strands to provide a comprehensive understanding of caregivers' experiences, information-seeking practices, and perspectives on digital health support. The quantitative findings are presented across three areas: (1) the context of antibiotic use in childhood illnesses, (2) ownership of mobile devices and access to health information, and (3) factors associated with mobile device use for child health care among caregivers. The qualitative analysis

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generated three overarching themes: (1) navigating health care and antibiotic treatment; (2) active and child-focused digital health information seeking; and (3) from accessible information to trusted, professionally supported digital health tools. These themes were further explored through related subthemes.

Quantitative Findings

Baseline Characteristics of Caregivers

For the quantitative household survey, a total of 460 households were approached. Of these, 10 households declined to participate due to time constraints, and 450 households were successfully recruited and completed the survey. The majority of participants (432/450, 96%, 95% CI 93.8%-97.5%) were female. The median age was 31 (IQR 27-36) years. Half of the caregivers lived with their parents-in-law. Educational attainment was moderate, with one-third completing secondary school (149/450, 33.1%, 95% CI 28.9%-37.6%). Half of the families (234/450, 52%, 95% CI 47.4%-56.6%) had a monthly income below US $400. Demographic characteristics were similar between urban and rural caregivers, except that urban households had higher monthly incomes. Further details are presented in Table 1.

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Table 1. Baseline characteristics of caregivers in the household survey.

Characteristics of caregivers	Total (n=450)	95% CI	Urban (n=225)	95% CI	Rural (n=225)	95% CI
Age (years), median (IQR)	31 (27-36)	—[a]	32 (27-35)	—	31 (27-36)	—
Sex, n (%)						
Female	432 (96)	93.8-97.5	210 (93.3)	89.3-95.9	222 (98.7)	96.2-99.5
Male	18 (4)	2.5-6.2	15 (6.7)	4.1-10.7	3 (1.3)	0.5-3.8
Religion, n (%)						
Yes	95 (21.1)	17.6-25.1	84 (37.3)	31.3-43.8	11 (4.9)	2.8-8.5
No	355 (78.9)	74.9-82.4	141 (62.7)	56.2-68.7	214 (95.1)	91.5-97.2
Role of caregiver, n (%)						
Mother	432 (96)	93.8-97.5	210 (93.4)	89.3-95.9	222 (98.7)	96.2-99.5
Father	17 (3.8)	2.4-6.0	14 (6.2)	3.7-10.2	3 (1.3)	0.5-3.8
Grandmother	1 (0.2)	0-1.2	1 (0.4)	0.1-2.5	0 (0)	0-1.7
Role in household						
Head	14 (3.1)	1.9-5.2	11 (4.9)	2.8-8.5	3 (1.3)	0.5-3.8
Head’s spouse	179 (39.8)	35.4-44.4	103 (45.7)	38.4-52.3	76 (33.8)	27.9-40.2
Head’s children	26 (5.8)	4.0-8.3	15 (6.7)	4.1-10.7	11 (4.9)	2.8-8.5
Head’s children in-law	226 (50.2)	45.6-54.8	94 (41.8)	35.5-48.3	132 (58.7)	52.1-64.9
Other	5 (1.1)	0.5-2.6	2 (0.9)	0.2-3.2	3 (1.3)	0.5-3.8
Level of education, n (%)						
Lower secondary[b]	149 (33.1)	28.9-37.6	66 (29.3)	23.8-35.6	83 (36.9)	30.9-43.4
Upper secondary[c]	173 (38.4)	34.1-43.0	94 (41.8)	35.5-48.3	79 (35.1)	29.2-41.6
College	29 (6.4)	4.5-9.1	15 (6.7)	4.1-10.7	14 (6.2)	3.7-10.2
University	67 (14.9)	11.9-18.5	32 (13.8)	10.3-19.4	35 (15.6)	11.4-20.9
Other	32 (7.1)	5.1-9.9	18 (8)	5.1-12.3	14 (6.2)	3.7-10.2
Occupation, n (%)						
Farmer	11 (2.4)	1.4-4.3	7 (3.1)	1.5-6.3	4 (1.8)	0.7-4.5
Contract employee	285 (63.3)	58.8-67.7	140 (62.2)	55.7-68.3	145 (64.4)	58.0-70.4
Business	61 (13.6)	10.7-17.0	31 (13.8)	9.9-18.9	30 (13.3)	9.5-18.4
Housewife	28 (6.2)	4.3-8.8	18 (8)	5.1-12.3	10 (4.4)	2.4-8.0
Other	65 (14.5)	11.5-18.0	29 (12.9)	9.1-17.9	36 (16)	11.8-21.4
Family income per month (US $), n (%)						
≤400	234 (52)	47.4-56.6	81 (36)	30-42.5	153 (68)	61.6-73.7
>400	216 (48)	43.4-52.6	144 (64)	57.5-70	72 (32)	26.3-38.4
Ownership of device[d], n (%)						
Smartphone	379 (84.2)	80.6-87.3	223 (99.1)	96.8-99.8	156 (69.3)	63-75
Basic mobile phone	248 (55.1)	50.5-59.6	130 (57.8)	51.2-64	118 (52.4)	45.9-58.9
Laptop	106 (23.6)	19.9-27.7	63 (28)	22.5-34.2	43 (19.1)	14.5-24.8
Desktop computer	52 (11.6)	8.9-14.8	31 (13.8)	9.9-18.9	21 (9.3)	6.2-13.8
Tablet	14 (3.1)	1.9-5.2	8 (3.6)	1.8-6.9	6 (2.7)	1.2-5.7
Landline phone	2 (0.4)	0.1-1.6	1 (0.4)	0.1-2.5	1 (0.4)	0.1-2.5
Internet access	444 (98.7)	97.1-99.4	223 (99.1)	96.8-99.8	221 (98.2)	95.5-99.3
Sources of trusted health information[d], n (%)						

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Characteristics of caregivers	Total (n=450)	95% CI	Urban (n=225)	95% CI	Rural (n=225)	95% CI
Health care workers	364 (80.9)	77.0-84.3	154 (68.4)	62.1-74.2	210 (93.3)	89.3-95.9
Drug sellers	269 (59.8)	55.2-64.2	106 (47.1)	40.7-53.6	163 (72.4)	66.3-77.9
Internet	184 (40.9)	36.4-45.5	87 (38.7)	32.5-45.2	97 (43.1)	36.8-49.6
Relatives/friends	136 (30.2)	26.2-34.6	37 (16.4)	12.2-21.8	99 (44)	37.7-50.5
Social media	132 (29.3)	25.3-33.7	60 (26.7)	21.3-32.8	72 (32)	26.3-38.4
TV	40 (8.9)	6.6-11.9	18 (8)	5.1-12.3	22 (9.8)	6.5-14.4
Magazine/journal	26 (5.8)	4.0-8.3	8 (3.6)	1.8-6.9	18 (8.0)	5.1-12.3
Source of antibiotic information[d](n=107), n (%)						
Doctors	88 (82.2)	73.9-88.3	57 (79.2)	68.4-86.9	31 (88.6)	74-95.5
Drug sellers	79 (73.8)	64.8-81.2	53 (73.6)	62.4-82.4	26 (74.3)	57.9-85.8
Relatives/friends	15 (14)	8.7-21.8	7 (9.7)	4.8-18.7	8 (22.9)	12.1-39
Internet	29 (27.1)	19.6-36.2	15 (20.8)	13.1-31.6	14 (40)	25.6-56.4
Social media use, n (%)						
Yes	420 (93.3)	90.6-95.3	217 (96.4)	93.1-98.2	203 (90.2)	85.6-93.5
No	30 (6.7)	4.7-9.4	8 (3.6)	1.8-6.9	22 (9.8)	6.5-14.4
Using mobile devices for seeking health information[d] (n=426), n (%)						
Often	54 (12.7)	9.8-16.1	31 (14.1)	10.1-19.3	23 (11.2)	7.6-16.2
Sometimes	288 (67.6)	63.1-71.9	133 (60.5)	53.9-66.7	155 (75.2)	68.9-80.6
Never	84 (19.7)	16.2-23.7	56 (25.4)	20.2-31.6	28 (13.6)	9.6-18.9

[a]Not applicable.

[b]Lower secondary education indicates completion of 9 years of schooling.

[c]Upper secondary education indicates completion of 12 years of schooling.

[d]Multiple selections were allowed, so respondents could be counted in more than 1 category. Because of missing values, n indicates the number of patients for whom data were available.

Context of Antibiotic Use in Childhood Illnesses

A total of 534 children were included in the survey, with a similar distribution of females (46.8%, 250/534) and males (53.2%, 284/534). Thirty-two (6%) children were admitted to hospital within the previous 6 months. In the 12 months preceding the survey, cough was the most commonly reported symptom, affecting 66.5% (355/534) of children, followed by fever (57.3%, 306/534) and diarrhea (15.9%, 85/534). Antibiotics were commonly used for these illnesses, particularly for cough and fever. Antibiotic treatment was reported more frequently among urban than rural children (Table S1 in Multimedia Appendix 5). The main sources of antibiotic information were doctors, reported by 82.2% (88/107, 95% CI 73.9%-88.3%) of participants, and medicine sellers/pharmacists, reported by 73.8% (79/107, 95% CI 64.8%-81.2%) of participants. Other sources included the internet, reported by 27.1% (29/107, 95% CI 19.6%-36.2%), and relatives or friends, reported by 14% (15/107, 95% CI 8.7%-21.8%; Table 1).

Caregivers demonstrated mixed knowledge and attitudes regarding antibiotics. While nearly half of caregivers correctly identified antibiotics as medicines used to treat infections (49.9%, 224/449), misconceptions remained: 20.5% (92/449) thought they were painkillers. A further 7.3% (33/449) of respondents thought antibiotics could relieve general weakness, and 17.6% (79/449) did not know what antibiotics were. Although most caregivers (287/297, 96.6%) agreed that antibiotics should not be used unnecessarily, a notable proportion reported attitudes that may contribute to unnecessary antibiotic use, including requesting antibiotics (64/297, 21.5%), taking them as soon as they feel unwell (52/297, 17.5%), using “strong” antibiotics (43/297, 14.5%), or combining multiple antibiotics to ensure recovery (34/297, 11.4%; Figure S1 in Multimedia Appendix 5).

Ownership of Mobile Devices and Access to Health Information

Among 450 households, almost all (444/450, 98.7%, 95% CI 97.1%-99.4%) had an internet connection. The majority of caregivers (379/450, 84.2%, 95% CI 80.6%-87.3%) owned smartphones, and half of them (248/450, 55.1%, 95% CI 50.5%-59.65%) owned basic mobile phones. Additionally, 23.6% (106/450) owned a laptop, 11.6% (52/450) owned a desktop computer, 3.1% (14/450) owned tablets, and 0.4% (2/450) owned a landline phone (Table 1). The sources of information that caregivers indicated they trusted included health care workers (364/450, 80.9%, 95% CI 77%-84.3%), followed by drug sellers (269/450, 59.8%, 95% CI 55.2%-64.2%), searchable websites (184/450, 40.9%, 95% CI 36.4%-45.5%), relatives/friends (136/450, 30.2%, 95% CI 26.2%-34.6%), and

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interactive social media platforms (132/450, 29.3%, 95% CI 25.3%-33.7%). The proportions of caregivers who trusted health care workers and drug sellers were higher among rural than urban caregivers. Almost all caregivers (420/450, 93.3%, 95% CI 90.6%-95.3%) used interactive social media platforms (Zalo and Facebook Messenger) every day. However, among them, only a minority of caregivers (54/426, 12.7%, 95% CI 9.8%-16.1%; 24 caregivers with missing data for the main outcome) often used smart mobile devices (smartphones and tablets) to seek health care information, whereas 67.6% (288/426, 95% CI 63.1%-71.9%) used them occasionally and 19.7% (84/426, 95% CI 16.2%-23.7%) never used them (Table 1). A quarter of caregivers (114/450, 25.3%, 95% CI 21.5%-29.5%) were familiar with health-related applications, and among them, 71.1% (81/114, 95% CI 62.1%-78.6%) had used these applications, such as pregnancy monitoring applications. Other details are presented in Table 1.

Factors Associated With Mobile Device Use for Child Health Care Among Caregivers

Multivariable regression analysis found that older caregivers were less likely to seek health information online than younger participants (aOR 0.65, 95% CI 0.43-0.99). Caregivers with higher levels of education had significantly higher odds of engaging in online health information–seeking behavior (aOR 2.73, 95% CI 1.61-4.61). Caregivers living in the urban commune were less likely to seek health-related information online using mobile devices than caregivers in the rural commune (aOR 0.45, 95% CI 0.24-0.85; Table 2). The less frequent outcome category included 84 participants, and the final model contained 8 parameters, giving an events-per-variable ratio above commonly recommended thresholds (ratio: 1 parameter per 10 events). All VIF values were low (range 1.01-1.21), indicating no evidence of problematic multicollinearity among the variables included in the final multivariable logistic regression model. The Hosmer-Lemeshow goodness-of-fit test was not significant (χ^2_8=5.8; *P*=.67), suggesting an adequate model fit.

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Table 2. Factors associated with mobile phone use for child health care among caregivers (n=450).

Characteristic	Using mobile devices for health care, n (%)	Crude OR[a]	Crude 95% CI	Adjusted OR[b]	Adjusted 95% CI
Gender					
Male	13 (76.5)	Reference	—[c]	—	—
Female	329 (80.4)	1.27	0.40-3.98	0.98	0.29-3.35
Age (years)					
10	—	0.57	0.39-0.85	0.65	0.43-0.99
Religion (yes or no)					
No	279 (83)	Reference	—	—	—
Yes	63 (70)	0.48	0.28-0.81	0.57	0.31-1.05
Monthly income (US $)					
≤400	173 (81.2)	Reference	—	—	—
>400	169 (79.3)	0.89	0.55-1.43	1.05	0.6-1.83
Education level					
Secondary school or below	95 (68.3)	Reference	—	—	—
High school or higher	247 (86.1)	2.65	1.62-4.34	2.73	1.61-4.61
Area					
Rural	178 (86.4)	Reference	—	—	—
Urban	164 (74.5)	0.46	0.28-0.76	0.45	0.24-0.85
Social media use					
No	3 (50)	Reference	—	—	—
Yes	339 (80.7)	4.19	0.83-21.12	3.44	0.51-23.35
Ownership of smart mobile devices					
No	34 (80.9)	Reference	—	—	—
Yes	308 (80.2)	0.95	0.42-2.14	1.43	0.54-3.78

[a]OR: odds ratio.

[b]Adjusted ORs were estimated using a logistic regression model that included the following 8 predefined variables: age, gender, religion, income, education, area of residence, social media use, and ownership of a smartphone, tablet, or other smart mobile device.

[c]Not applicable.

Qualitative Findings

Interview Participants

In the qualitative component, 60 caregivers were approached. Of these, 22 caregivers declined to participate due to time constraints and discomfort with discussing the topic, while 38 caregivers participated in qualitative interviews (4 FGDs and 6 IDIs). The participants had an average age of 33 (SD 6.08) years, ranging from 18 to 42 years. The sample was predominantly female, with 37 (97.4%) female participants and only 1 (2.6%) male participant. In terms of occupation, 20 (52.6%) participants were housewives or informal workers, 7 (18.4%) were factory workers, and 4 (10.5%) were farmers. Participants had between 1 and 4 children, with an average of 1.8 children per family; 27 (71.1%) participants had 2 children. The children's ages ranged from 6 months to 16 years (Table 3).

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Table 3. Characteristics of caregivers (n=38) in in-depth interviews and focus group discussions.

Characteristic	Frequency
Age (years), mean (SD; range)	33 (6.08; 18-42)
Gender, n (%)	
Female	37 (97.4)
Male	1 (2.6)
Occupation, n (%)	
Housewife	20 (52.6)
Contracted workers	7 (18.4)
Farmers	4 (10.5)
Other	7 (18.4)
Number of children in the family, mean (range)	1.8 (1-4)
Age of children, range	6 months to 16 years
Residence, n (%)	
Urban	19 (50)
Rural	19 (50)

Overview of Qualitative Findings

The thematic analysis generated 3 overarching themes describing caregivers' experiences of health care seeking, antibiotic use, and engagement with digital health information. The first theme, "navigating health care and antibiotic treatment," describes caregivers' experiences of managing childhood illness, seeking health care, accessing antibiotics, and understanding antibiotic use. The second theme, "active and child-focused digital health information seeking," captures caregivers' proactive use of mobile devices and online resources to seek, cross-check, and contextualize health information, particularly when making decisions about their children's health and medicines. The third theme, "from accessible information to trusted, professionally supported digital health tools," describes caregivers' concerns about the credibility of online health information and their preferences for accessible digital platforms that provide reliable information and professional support. These overarching themes were further developed into related subthemes, which are presented below with supporting accounts and illustrative quotations from participants.

Navigating Health Care and Antibiotic Treatment

Health care seeking and antibiotic access were predominantly facility- and pharmacy-based. Caregivers most commonly sought care from private pharmacies/drug stores and private hospitals/clinics, while public facilities served as a secondary source of care for episodes of cough, fever, and diarrhea (Figure S2 in Multimedia Appendix 5). Antibiotic access followed a similar pattern, with antibiotics mainly being obtained from private hospitals/clinics and private drug stores, followed by public facilities. Accessing antibiotics from informal sources (eg, retired doctors, relatives/friends, street vendors, traditional healers) was uncommon (Figure S3 in Multimedia Appendix 5).

Caregivers typically followed a sequential and pragmatic approach when seeking health care and antibiotics for children aged 5 years or younger. This pathway often began with home-based care and progressed to higher levels of the health care system depending on the perceived severity and persistence of the child's symptoms. The process generally followed four stages: (1) home treatment; (2) consultation at private clinics or pharmacies; (3) visits to the primary health care units (CHCs); and (4) referral to or self-initiated visits to higher-tier hospitals, such as the Provincial Paediatric Hospital or the National Children's Hospital.

Conceptions About Antibiotics and AMR

Caregivers demonstrated limited knowledge of the classification, use, and potential effects of antibiotics in children. For many, antibiotics were viewed simply as common medicines that facilitate rapid recovery from respiratory infections, particularly when children experienced symptoms such as cough or fever. As one caregiver explained:

> *Antibiotics are used to reduce inflammation, for example, for a sore throat or when the children have tonsillitis. Usually, when we go to the health centre, the doctor prescribes them.* [Rural FGD 1, 38-year-old mother with 2 children]

Across all 4 FGDs, participants did not provide accurate information about the definition or classification of antibiotics, suggesting a limited conceptual understanding of these medicines. Nevertheless, participants demonstrated some awareness of the potential harms associated with antibiotic use. As one caregiver noted, "(Antibiotics) are fast but not good for the children, with many harmful aspects" (Urban FGD 2, 27-year-old mother with 2 children). Another explained:

> *No one wants their child to take too many antibiotics… but I'm afraid my child will be sick for a long time… I don't have professional knowledge, so I agreed to use antibiotics.* [Rural FGD 1, 34-year-old mother with 2 children]

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These accounts suggest that although caregivers recognized that antibiotics could have harmful effects, this awareness did not necessarily translate into a clear understanding of when antibiotics should be used or how they should be used.

AMR was a relatively new and unfamiliar concept to most caregivers. While some had encountered the term, their understanding of its implications was limited and often shaped by personal experiences with recurring illness. One caregiver described AMR as a situation in which "every time my child gets sick, he has to take antibiotics to get better, otherwise he won't get better, only gets a little better and then gets sick again" (Rural IDI 3, 38-year-old mother with 2 children). Despite this limited knowledge, caregivers expressed genuine curiosity about AMR and a strong motivation to learn more, particularly about how antibiotic use could affect their children's future health.

Active and Child-Focused Digital Health Information Seeking

Caregivers expressed support for using mobile devices to access health care information and support health care decision-making for their children. Caregivers reported seeking additional information through online and mobile resources alongside information provided by health care professionals to support their understanding of health care and medication-related decisions for their children. Caregivers were proactive in seeking, validating, and contextualizing health information online, particularly when they were uncertain about treatment recommendations for their children. They reported using online resources and mobile communication platforms to cross-check advice received from health care providers or other sources. As one participant explained, "I should check on my phone because sometimes doctors make mistakes or myself make mistakes" (Urban IDI 3, 33-year-old mother with 1 child). Caregivers also actively sought information about medicines prescribed for their children, particularly their uses and dosage:

> *I just keep researching about the uses and dosage… not the price as the price should be different between different providers (pharmacies, hospitals and private clinics).* [Urban IDI 3, 33-year-old mother with 1 child]

Caregivers prioritized searching for information about medicines, particularly their names, how they work, and potential side effects, when medications, including antibiotics, were prescribed for their children. As one participant explained, "I will search for the drug the pharmacist sold for my children. I do not do it for drugs for me or my husband" (Urban IDI 1, 33-year-old mother with 2 children). Caregivers reported that because children are still in their developmental stage, they considered them more vulnerable to the effects of medicines and therefore believed that greater caution was required. In contrast, adults were viewed as more resilient, leading caregivers to rely more readily on health care professionals' expertise.

From Accessible Information to Trusted Digital Health Tools

Reliance on Online and Social Networks for Health Information

Caregivers reported relying primarily on readily available digital health information, particularly information presented in online search results, with limited critical evaluation of the quality and credibility of the information accessed. They did not generally describe assessing how search results were ranked and, in some cases, reported difficulties in identifying reliable information when multiple sources provided differing or conflicting information. When searching for online health and antibiotic-related information, caregivers primarily relied on the Google search engine as their first point of reference. As one caregiver explained, "If you don't know something, you can look it up on Google" (Rural IDI 1, 33-year-old mother with 3 children). Most caregivers used simple keyword combinations (eg, "symptom + health care for age group") to retrieve information, yet they often lacked effective strategies for assessing the reliability or credibility of online sources. As several participants noted, "I just click on the first one that appears and read it" (Urban IDI 2, 30-year-old mother with 2 children) and "We just go to Google to search and read" (Rural FGD 1, 38-year-old mother with 2 children). Participants described a tendency to select the first search result displayed by Google and to read and apply the information it contained.

Caregivers frequently sought advice from informal networks—such as older relatives, neighbors, or friends perceived to have medical knowledge, often through messaging applications such as Facebook Messenger or Zalo. These exchanges reflect the influence of multigenerational households and community-based advice in Vietnamese culture but may create tensions when traditional beliefs conflict with evidence-based practices. Younger caregivers, in particular, described navigating between information obtained online and guidance from older relatives, highlighting the need for trustworthy and accessible health resources. Social media groups on platforms such as Facebook and Zalo also served as common sources of parenting and health care information, although caregivers reported that credible content could be difficult to identify.

Expectations for Trusted, Professionally Supported Online Health Tools for Health Care, Including Antibiotic Use

Caregivers expressed a strong desire for accessible, trustworthy, and professionally supported online platforms to guide their health care decisions, particularly regarding antibiotic use in young children. While many currently relied on general search engines and informal networks, they acknowledged the limitations of these sources and the risk of misinformation. As one participant explained: "(when searching for health care information on Google) I am just afraid of being deceived. It is just for reference" (Urban FGD 1, 27-year-old mother with 2 children). They therefore articulated a clear expectation for an online tool or digital platform—such as a mobile app, moderated social media group, or website—to provide scientifically accurate and child-specific health care information.

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Crucially, caregivers emphasized the importance of integrating professional medical support into these tools. They envisioned platforms where qualified doctors or other health professionals could respond to questions, provide advice, and offer reassurance:

> *We should follow the (social media) pages of doctors who we know or who are recommended by our relatives, friends such as Dr. X or Dr. Y who are paediatricians and have good advice on medicine and supplements for children.* [Urban FGD 1, 27-year-old mother with 2 children]

One caregiver described an ideal scenario:

> *Many of the groups you join will be consultants or if you have any questions, I'll write them on that page and then the doctor will be the one to answer.* [Urban FGD 1, 23-year-old mother with 1 child]

Integration of the Quantitative and Qualitative Findings

The quantitative and qualitative findings were integrated using a joint display to identify areas of convergence and complementarity. The 2 datasets converged on caregivers' limited understanding of antibiotics and their active engagement with digital health information. Quantitative findings demonstrated frequent antibiotic use for childhood illnesses and identified differences in mobile-based health information seeking by caregiver age, education, and residential setting. Qualitative findings complemented these results by describing caregivers' active use of online and mobile resources to seek, cross-check, and contextualize information about their children's health and medications. The qualitative findings further expanded the quantitative results by identifying caregivers' preferences for accessible, trustworthy, and professionally supported digital health tools (Table 4).

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Table 4. Integration of quantitative and qualitative findings on antibiotic use and digital health information–seeking behaviors.

Theme	Quantitative findings	Qualitative quotes	Integrated finding
Context of antibiotic use in childhood illness	• Antibiotic use was commonly reported for cough (221/355, 62.3%) and fever (144/306, 47.1%) • Misconceptions included identifying antibiotics as painkillers (92/449, 20.5%) or medicines for general weakness (33/449, 7.3%)	• "Antibiotics are used to reduce inflammation, for example, for a sore throat or when the children have tonsillitis." (Rural FGD 1, 38-year-old mother with 2 children) • "Every time my child gets sick, he has to take antibiotics to get better, otherwise he won't get better, only gets a little better and then gets sick again." (Rural IDI 3, 38-year-old mother with two children)	• The qualitative findings complemented the quantitative results by providing greater detail on caregivers' misconceptions and understanding of antibiotics and AMR[a]
Access to mobile devices and digital information	• Internet access was nearly universal (444/450, 98.7%) • A total of 80.2% (308/384) of caregivers used mobile devices for child health information • A further 27.1% (29/107) of caregivers sought antibiotic-related information online	• "If you don't know something, you can look it up on Google." (Rural IDI 1, 33-year-old mother with 3 children)	• High digital access was accompanied by active use of online resources for child health information, although general health information–seeking may not necessarily translate into antibiotic-specific digital engagement
Factors associated with online health information seeking	• Older age (aOR[b] 0.65, 95% CI 0.43-0.99) and urban residence (aOR 0.45, 95% CI 0.24-0.85) were associated with lower odds of mobile-based online health information seeking, while higher education was associated with higher odds (aOR 2.73, 95% CI 1.61-4.61)	• "I will search for the drug the pharmacist sold for my children. I do not do it for drugs for me or my husband." (Urban IDI 1, 33-year-old mother with 2 children)	• Qualitative findings provided context for the observed demographic associations and described how caregivers used digital information
Trusted sources and evaluation of health information	• Health care workers were the most trusted source (364/450, 80.9%), followed by drug sellers (269/450, 59.8%), searchable websites (184/450, 40.9%), relatives/friends (136/450, 30.2%), and social media (132/450, 29.3%)	• "I just click on the first one that appears and read it." (Urban IDI 2, 30-year-old mother with 2 children) • "When searching for health care information on Google, I am just afraid of being deceived. It is just for reference." (Urban FGD 1, 27-year-old mother with 2 children)	• Both datasets highlighted health professionals as trusted sources alongside diverse digital and informal information sources, but caregivers often lacked strategies to assess online information credibility
Preferred digital health support	• Daily social media use was high (420/450, 93.3%), but frequent mobile health-information seeking was low (54/426, 12.7%; occasional 288/426, 67.6%, never 84/426, 19.7%). • A further 25.3% (114/450) of caregivers were familiar with health apps, and 71% (81/114) had used them	• "We should follow the (social media) pages of doctors who we know or whom our relatives, friends recommended such as Dr. X or Dr. Y who are paediatricians and have good advice on medicine and supplements for children." (Urban FGD 1, 27-year-old mother with 2 children)	• The quantitative and qualitative findings show complementarity: although social media use was widespread, caregivers' use of it for health information was more selective, with qualitative data indicating a preference for trusted, professionally credible sources

[a]AMR: antimicrobial resistance.

[b]aOR: adjusted odds ratio.

Discussion

Principal Findings

To the best of our knowledge, this was the first study in Vietnam investigating the association between mobile technology engagement and health care information–seeking behavior among caregivers of children, with a particular focus on antibiotic-related information seeking. The study findings identified a high level of antibiotic use among children aged 5 years or younger, particularly for symptoms such as cough (221/355, 62.3%) and fever (144/306, 47.1%), with antibiotics frequently obtained through private clinics and pharmacies, consistent with previous reports [3,5,28]. Although the majority of caregivers perceived themselves as knowledgeable about antibiotics, important gaps in understanding remained, including uncertainty or misconceptions about what antibiotics are and how they work, indicating room for improvement. mHealth interventions offer a scalable and context-appropriate approach to address these gaps by providing targeted education, reinforcing appropriate antibiotic use behaviors, supporting caregiver decision-making, and promoting antimicrobial

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stewardship at the community level. Digital tools that assist caregivers in identifying medicines may also have a role; for example, QR-code-based approaches such as the ABACUS initiative have been proposed to help users distinguish antibiotics from other medicines [5].

Our findings indicate that digital platforms are already an important source of child health information for caregivers, with most households having internet access (444/450, 98.7%, 95% CI 97.1%-99.4%) and a substantial proportion of caregivers using mobile devices to seek information about their children's health (308/384, 80.2%, 95% CI 75.9%-83.9%). This high level of engagement is consistent with evidence showing that parents commonly use the internet to obtain information about their children's health and to inform health care decisions. A systematic review by Kubb et al [29] found that parents frequently use online health information, with education being one of the more consistent predictors of online health information–seeking behavior. In our study, caregivers with higher educational attainment were more likely to engage in online health information–seeking (aOR 2.73, 95% CI 1.61-4.61), suggesting that differences in digital and health literacy may influence caregivers' ability and confidence to access and use online resources. The lower likelihood of online information-seeking among those living in urban areas (aOR 0.45, 95% CI 0.24-0.85) further demonstrates the importance of understanding local patterns of health care access and information use. This association differs from findings in some previous mHealth studies [30,31] and may partly reflect the relatively small geographic and digital differences between the study settings. Caregivers in the rural commune may have had greater motivation to seek online information because they had fewer alternative sources of child health information, whereas those in the district town may have had greater access to face-to-face health care services. Residual confounding by unmeasured socioeconomic or cultural factors, including religious composition, may also have contributed to the association. Nevertheless, the finding illustrates why mHealth interventions should be informed by users' actual health-seeking contexts rather than assuming that urban caregivers will necessarily be more digitally engaged.

The findings also demonstrate that there is unlikely to be a single optimal digital delivery channel for all caregivers. Older caregivers were less likely to seek child health information online than younger caregivers (aOR 0.65, 95% CI 0.43-0.99), suggesting that interventions relying heavily on online platforms may preferentially reach younger caregivers. A combination of approaches may therefore be more appropriate, with social media potentially useful for younger users and SMS or professionally supported websites providing alternative channels for those who engage less with online information. This differentiated approach may help broaden the reach of digital health interventions across caregivers with different patterns of digital engagement. Although mobile phone–based health information–seeking was relatively common among caregivers (308/384, 80.2%, 95% CI 75.9%-83.9%), only 27.1% (29/107, 95% CI 19.6%-36.2%) of caregivers reported using the internet to obtain antibiotic-related information, suggesting that general health information–seeking may not necessarily translate into antibiotic-specific digital engagement. Therefore, mHealth interventions aimed at supporting antibiotic stewardship should consider this distinction to effectively engage the target population. Importantly, the qualitative findings showed that caregivers actively sought online information to improve their knowledge and confidence in making decisions about childcare and treatment, while expressing a preference for trustworthy and professionally supported sources, particularly given the increasing prominence of AI-generated content in search results, which may increase the difficulty of identifying reliable information and potentially contribute to the spread of misinformation. This is consistent with previous qualitative evidence showing that parents value online information for increasing knowledge and reassurance but are also concerned about the trustworthiness and quality of available information [32].

Crucially, caregivers emphasized the importance of integrating professional medical support into these tools. They envisioned platforms where qualified doctors or other health care professionals could respond to questions, provide advice, and offer reassurance. This highlights both the demand for real-time expert engagement and caregivers' preference for interactive, rather than purely informational, digital solutions, suggesting an opportunity to integrate expert moderation into community-based digital platforms (eg, messaging services, peer-support groups, or moderated forums). These findings suggest an opportunity to develop accessible, credible, and locally relevant digital health resources, particularly those providing reliable information on childhood illness and antibiotic use. Such interventions should complement, rather than replace, professional health care services, consistent with World Health Organization (WHO) guidance on the potential and limitations of mobile phone–based digital health interventions [33].

Taken together, these findings suggest a potential role for mHealth interventions in supporting more informed antibiotic use decisions in the community. The widespread use of mobile devices and existing online information-seeking behaviors provide a foundation for such interventions, while the identified differences by age, education, and residency highlight the need for flexible delivery strategies. Importantly, the study identifies the behavioral needs, existing digital practices and user preferences that should inform the development and subsequent evaluation of such interventions.

Lessons can be learned from mHealth interventions targeting antibiotic use across both LMICs and high-income settings. For example, studies in Nepal and Kenya have used SMS, smartphone apps, mobile surveillance, and digital education to address community antibiotic consumption, prescribing, and dispensing [34,35]. Meanwhile, interventions in high-income settings such as Singapore and New Zealand have used smartphone-based education and antibiotic guideline applications to improve antibiotic knowledge and prescribing practices [36,37]. In Vietnam, a systematic review of 14 studies involving 5660 participants aged 21 to 61 years similarly found that mHealth apps positively influenced health behavior change and health care service use [38].

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Limitations

Despite these strengths, the study has several limitations that should be considered when interpreting the study findings. First, the study was conducted among caregivers of children aged 5 years or younger in 2 communes (1 district town and 1 rural commune) in a single province of Vietnam, which may limit the generalizability of the results to a broader population. Second, the survey relied on caregivers' self-reported experiences over the preceding 12 months. This period was intentionally selected to capture broader patterns of mobile technology engagement and health care information–seeking behavior. However, the longer recall period may have introduced recall and reporting bias, particularly when recalling specific antibiotic use and health care–seeking episodes. Future studies could combine assessment of longer-term digital engagement with shorter recall periods or prospective follow-up to improve the accuracy of reported antibiotic use and health care–seeking behaviors. Third, the questionnaire was symptom-specific and therefore lacked variables indicating the overall number of children treated with antibiotics and the total number of antibiotic courses used. This limited our ability to estimate and compare overall antibiotic use in the study population. Furthermore, although high antibiotic use among children was reported, the study design did not allow us to assess whether antibiotic use was clinically appropriate or inappropriate. Fourth, a notable limitation relates to the sex and roles of caregivers included in the study. The research primarily focused on mothers, potentially overlooking the significant influence of other caregivers, such as fathers, parents-in-law, grandparents, and other extended family members, who may play important roles in health care decision-making for children in Vietnamese households. Nevertheless, our qualitative findings partly captured these complex family dynamics and diverse perspectives within extended families. Fifth, a limitation of the qualitative component is that, in the absence of an independent observer, no repeat interviews, transcript verification, or participant review of the findings were conducted. Future studies could incorporate these approaches to obtain participant feedback and strengthen the credibility of the findings. Lastly, the study was conducted before the widespread integration of AI-generated content into online search engines. As digital information-seeking has evolved, these findings provide a useful baseline for future research assessing how AI-mediated information environments may influence caregivers' digital health literacy and antibiotic-related decision-making.

Overall, the findings suggest that antibiotic use among children aged 5 years or younger remains common, alongside gaps in caregivers' antibiotic knowledge and substantial engagement with mobile technologies for health information. These findings highlight the potential role of mHealth in supporting informed antibiotic use decisions. Interpretation should be cautious given the study's limited geographical scope, reliance on self-reported behaviors over a 12-month recall period, potential residual confounding, and the possibility of chance findings from multiple analyses. The findings may also have limited generalizability beyond the study population. Nevertheless, they are broadly consistent with previous evidence and provide a useful basis for informing the design and future evaluation of context-appropriate mHealth interventions.

Conclusion

This study provides insights into caregivers' health information–seeking behaviors and engagement with digital technologies for antibiotic-related information. The findings suggest that mHealth interventions may be a feasible and potentially useful approach to support informed antibiotic use and deliver caregiver-focused health information. Further research should explore caregivers' needs and preferences to inform the design and development of acceptable and context-appropriate mHealth interventions in Vietnam.

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Generative AI Use

ChatGPT-5.6 (OpenAI) was used in the preparation of this work as a supplementary tool to identify potentially relevant references and to assist with proofreading and editing to improve clarity, grammar, and readability. Appropriate keywords and research topics were provided to ChatGPT to generate suggestions for potentially relevant academic literature and sources. All AI-identified references were independently assessed and verified by the first author using the full publications, appropriate academic databases, and original sources for relevance and accuracy. The authors take full responsibility for the selection, interpretation, verification, and final presentation of all information and content.

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Authors' Contributions

NTTD, HFLW, and SOL were responsible for the study conception and funding application. NTTD and HNTC led the data collection, performed data analysis, and drafted the manuscript. PBB was responsible for coordinating the study activities. HTD, TTBL, and VTK contributed to the study planning and supervised the local implementation. HRvD and SOL contributed to the study supervision and manuscript revision. All authors contributed sufficiently to the review and revision of the manuscript and approved the final version.

Conflicts of Interest

HRvD is a board member of Wellcome Surveillance and Epidemiology of Drug Resistant Infections Consortium (SEDRIC) and received travel and accommodation funding from bioMérieux to attend the workshop Rising to the Challenge: Utilizing Diagnostics to Combat Infectious Diseases and AMR, organised by AfricaCDC, AMR Action Fund, Aurobac Therapeutics, bioMérieux, and ESCMID. The other authors declare no conflicts of interest.

Multimedia Appendix 1

Household survey questionnaire.
[DOCX File , 44 KB-Multimedia Appendix 1]

Multimedia Appendix 2

Interview guide.
[DOCX File , 25 KB-Multimedia Appendix 2]

Multimedia Appendix 3

STROBE checklist.
[PDF File (Adobe PDF File), 116 KB-Multimedia Appendix 3]

Multimedia Appendix 4

COREQ checklist.
[PDF File (Adobe PDF File), 357 KB-Multimedia Appendix 4]

Multimedia Appendix 5

Baseline characteristics, knowledge, and sources of health care and antibiotics among participants.
[DOCX File , 175 KB-Multimedia Appendix 5]

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Abbreviations

aOR: adjusted odds ratio
ARI: acute respiratory infection
CHC: commune health center
FGD: focus group discussion
IDI: in-depth interview
mHealth: mobile health
STROBE: Strengthening the Reporting of Observational Studies in Epidemiology
VIF: variance inflation factor
WHO: World Health Organization

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