

# Antibiotic knowledge and behaviour amongst asylum seekers in Germany: the role of health literacy

**Hamida Alam**

University Medical Center Freiburg

**Amira Abudayyeh**

University Medical Center Freiburg

**Benedikt Spielberger**

University Medical Center Freiburg

**Anna Hansel**

University Medical Center Freiburg

**Siegbert Rieg**

University Medical Center Freiburg

**Diana Sahrai**

University of Education Freiburg

**Philipp Henneke**

University Medical Center Freiburg

**Anneke Donne Maree Haddad**

**anneke.haddad@uniklinik-freiburg.de**

University Medical Center Freiburg

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## Research Article

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# Antibiotic knowledge and behaviour amongst asylum seekers in Germany: the role of health literacy

[Authors' names and affiliations removed to facilitate double-anonymous peer review].

## Abstract

**Aims:** Antibiotic resistant infections are a growing global health threat and inappropriate antibiotic use is one key driver. Refugees and asylum seekers may be particularly vulnerable to both antibiotic resistant infections and inappropriate antibiotic use. Understanding antibiotic knowledge and behaviour in these populations is therefore essential. One central driver of health-related behaviour is health literacy (HL); refugees and asylum seekers encounter barriers to HL due to language, cultural differences, and limited access to reliable health information. This study sought to examine relationships between antibiotic knowledge/use and HL among adults at a German initial reception centre (*Landeserstaufnahmeeinrichtung*, LEA).

**Methods:** We conducted a cross-sectional questionnaire study with 106 LEA residents in Freiburg, Germany. Antibiotic knowledge and use were assessed using questions based on existing literature; HL was measured using the HLS-EU-16. Data were analysed using descriptive and inferential statistics.

**Results:** Nearly half of participants reported antibiotic use in the past 6 months. All reported inappropriate use, such as discontinuing treatment early or storing leftover medication. Explicit antibiotic knowledge was inconsistent. Around half of participants had adequate self-reported HL. Lower HL was significantly associated with more inappropriate antibiotic use over and above the effect of antibiotic knowledge. Exploratory analyses suggested differences between language subgroups, both in HL and in problematic antibiotic use.

**Conclusions:** Refugees and asylum seekers in this reception centre setting show substantial gaps in antibiotic knowledge and a high prevalence of stewardship-relevant misuse. Associations with low HL suggest that HL-focussed interventions, including targeted education and improvements in professional and organizational HL within refugee healthcare services, could be a useful lever for promoting antibiotic stewardship in this population.

## Keywords

Refugee healthcare; health literacy; antibiotics; antibiotic knowledge; antibiotic use; antimicrobial resistance

## Background

Inappropriate antibiotic use contributes significantly to antimicrobial resistant infections, which cause around 1.27 million deaths annually [1]. Such inappropriate use arises from a complex interplay of determinants, including prescribing under clinical uncertainty, system-level shortcomings, patient expectations, and widespread misconceptions about antibiotic benefits.

This is a global challenge, yet it is particularly acute amongst marginalised populations. These include refugees and asylum seekers, who are at heightened risk of infections due to, for example, missed vaccinations or overcrowded and unsanitary living conditions [2]. Infections in these populations are more frequently caused by antimicrobial resistant bacteria [3,4]. Vulnerability is further increased by inappropriate antibiotic use in refugee and asylum seeker populations, driven by differing healthcare practices and medication access in countries of origin, lack of reliable information and communication barriers in the host healthcare system [5–7].

One factor that may shape antibiotic-related behaviours is health literacy (HL), the ability to find health-relevant information, to understand and evaluate it, and to use it to promote and maintain health [8–10]. HL may influence infection-related behaviour in general and on antibiotic use in particular [11–14]. Importantly, HL is increasingly viewed as emerging from the interaction between individuals and the healthcare system [10,15]. Consequently, healthcare organisations can improve HL by providing accessible, clear, and linguistically and culturally appropriate health information [15,16] and ensuring comprehension e.g., by using “teach back” techniques [17].

Many adults experience limited HL. For example, a survey in eight European countries found that around 47% of people report limited HL [18]. In Germany, around half of the population report difficulties in finding, understanding, appraising and applying information on disease prevention [10,19]. Similarly, representative German data using a brief self-report measure, the HLS-EU-16, indicate that approximately 56% of adults report *adequate* HL; 32% have *problematic* HL and 12% have *inadequate* HL [19].

Importantly, HL varies between population subgroups [19]. Refugees and asylum seekers often face structural disadvantages and personal circumstances – such as disrupted education, lack of accessible health information due to language barriers, cultural differences – that limit HL. Navigating unfamiliar and complex health system in the host country and managing family health without adequate social support compound these challenges. Unsurprisingly, therefore, refugees in high-income countries experience lower HL than host populations [20–22], and this is associated with poor health outcomes [23].

Yet it remains unknown whether HL is specifically associated with antibiotic knowledge and use amongst refugees and asylum seekers. As HL is potentially modifiable, identifying links to poorer antibiotic knowledge and use could justify individual or organisational HL interventions to promote antibiotic stewardship in this population. We therefore aimed to assess antibiotic knowledge, attitudes and practices and HL amongst refugees and asylum seekers in our local setting. Specifically, we aimed to:

1. assess antibiotic knowledge and antibiotic behaviour amongst refugees and asylum seekers in an initial reception centre setting.
2. assess self-reported HL amongst refugees and asylum seekers.
3. examine differences in antibiotic knowledge and behaviour and HL based on age, education and language.
4. investigate relationships between antibiotic knowledge, antibiotic behaviour and HL in this population.

## Methods

### Participants

Participants were residents of the initial reception centre for refugees and asylum seekers (*Landeserstaufnahmeeinrichtung*, LEA) in Freiburg, Germany. Inclusion criteria were: age 16–65, literacy in one of the study languages (Arabic, Persian, Pashto, Turkish, or English), and <12 months' residency in Germany. Languages other than English were chosen based on study team proficiency; however, > 90% of LEA residents with a reported country of origin during the recruitment period were from a country where one of these languages is a primary and/or official language.

### Data collection

Data were collected between November 2024 and May 2025 at the Freiburg LEA. During this period, the LEA had between 367 and 512 residents, predominantly male (78% over the whole recruitment period); the most common reported countries of origin were Türkiye (30%), Syria (26%), Afghanistan (14%) and Algeria (11%).

Using a convenience sampling approach, trained bilingual interviewers approached individuals in the LEA health clinic waiting area; interested individuals received study information, provided written informed consent and completed paper questionnaires in private areas, typically taking 20-30 minutes. Bilingual staff assisted as required. A small sub-sample additionally took part in qualitative interviews about health literacy; results will be reported separately.

The Ethics Committee of the Medical Center – University of Freiburg approved the study (reference number 24-1300-S1). All participants provided written informed consent in their preferred language. Participation was voluntary, with the option to withdraw at any time without consequences. Data were anonymised and stored securely.

### Measures

Materials were available in Arabic, Persian (Dari), Pashto, Turkish, or English, translated by certified translators or native speakers familiar with medical terminology.

#### Antibiotic knowledge and use

Items were drawn from previous studies [12,24–27]. Knowledge was assessed using 20 statements (answer options *true*, *false* and *don't know*) covering relevant indications, side effects, and antimicrobial resistance. Antibiotic use was evaluated using 10 statements (answer options *never*, *sometimes* and *very often or always*) about inappropriate use (e.g., stopping early; saving for later use).

#### Health literacy

HL was measured using the HLS-EU-16 [18,28,29], which assesses ability to access, understand, appraise, and apply health-related information across three domains (health care, disease prevention and health promotion). Participants rate ease of health-information-related tasks on a Likert scale (1 = *very difficult*; 2 = *difficult*; 3 = *easy*; 4 = *very easy*). Reliability was good (omega total reliability coefficient = 0.926; Cronbach's alpha = 0.896).

## Demographic data

Participants reported their age group, gender, country of origin, education, time since arrival in Germany and rated their general health (1 = *very poor* to 5 = *very good*).

## Data analysis

Data were entered into and managed using Research Electronic Data Capture (REDCap) tools hosted at the Medical Center – University of Freiburg [30]. Non-English free text answers were translated by native speakers and entered into REDCap in English. Analyses were performed using RStudio Version 2024.12.1 [31], using packages DescTools [32], psych [33], ggplot2 [34] and ggthemes [35].

Due to distribution skews, several variables were recategorised: education from 7 into 5 levels (*no/little formal education; completed primary education; at least some secondary education; completed secondary education; or any higher education*); age group from 5 into 3 levels (*16-24 years; 25-34 years; 35 years and older*); general health from 5 into 2 levels (*very poor/poor/fair; good/very good*). Participants who completed questionnaires in English or Turkish ( $n = 1$  each) were excluded from language subgroup analyses. Other language subgroups were small; these analyses are therefore exploratory and results should be interpreted with caution.

Antibiotic knowledge scores were calculated as percentage of questions that were answered correctly; *don't know* answers were scored as incorrect. All participants answered  $\geq 80\%$  of questions. Problematic antibiotic use scores were calculated by summing the 10 items (*very often/always* = 2, *sometimes* = 1, *never* = 1; one item reverse scored). Participants who answered  $< 80\%$  of the questions were excluded ( $n=3$ ).

For HLS-EU-16 data, we used two approaches [28,36]:

1. HL categories: item-level responses were dichotomised (*difficult/very difficult* = 0; *easy/very easy* = 1) and summed; totals were then categorised as reflecting *inadequate* (0-8), *problematic* (9-12) or *sufficient* (12-16) HL. Participants with  $> 2$  missing values were excluded.
2. HL index: to preserve variance, an index (range 0-50) was calculated as  $\text{HL index} = (\text{participant mean} - 1) * 50/3$  and used for analyses examining relationships between HL and other variables.

Frequencies are presented as percentages. Due to ordinal Likert scales underlying several key variables (HL index, antibiotic knowledge and antibiotic use) and evidence for non-normal distributions (e.g., Shapiro-Wilk test for HL index:  $p = 0.005$ ; Shapiro-Wilk test for antibiotic misuse:  $p = 0.001$ ), non-parametric statistical methods were used: Kruskal-Wallis and Mann-Whitney U test for categorical variables (language, general health); Jonckheere-Terpstra test for ordered variables (education, age group) and Spearman rank correlations for associations. Pairwise comparisons were corrected using Holm's method. All tests were two tailed ( $\alpha = 0.05$ ). Missing values were handled via listwise deletion.

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## Results

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106 LEA residents took part; demographic characteristics are shown in Table 1.

*Table 1: Participant demographics*

| Variable               | Category                              | N (%)      |
|------------------------|---------------------------------------|------------|
| Gender                 | male                                  | 95 (89.6%) |
|                        | female                                | 10 (9.4%)  |
|                        | missing                               | 1 (0.9%)   |
| Family status          | single                                | 60 (56.6%) |
|                        | married                               | 42 (39.6%) |
|                        | other                                 | 2 (1.9%)   |
|                        | missing                               | 2 (1.9%)   |
| Age group              | 16-24 years                           | 50 (47.2%) |
|                        | 25-34 years                           | 39 (36.8%) |
|                        | 35 years and older                    | 16 (15.1%) |
|                        | missing                               | 1 (0.9%)   |
| Education              | No or little school education         | 16 (15.1%) |
|                        | Finished primary school               | 18 (17.0%) |
|                        | Attended secondary school             | 34 (32.1%) |
|                        | Finished secondary school             | 17 (16.0%) |
|                        | Attended or finished higher education | 21 (19.8%) |
| Country of origin      | Afghanistan                           | 41 (38.7%) |
|                        | Syria, Palestine or Iraq              | 36 (34.0%) |
|                        | Turkey                                | 1 (0.9%)   |
|                        | Iran                                  | 9 (8.5%)   |
|                        | North Africa or Somalia               | 19 (17.9%) |
| Questionnaire language | Dari                                  | 35 (33.0%) |
|                        | Arabic                                | 54 (50.9%) |
|                        | Turkish                               | 1 (0.9%)   |
|                        | Pashto                                | 15 (14.2%) |
|                        | English                               | 1 (0.9%)   |
| Weeks in Germany       | < 4 weeks                             | 36 (34.0%) |
|                        | 4 to < 8 weeks                        | 23 (21.7%) |
|                        | 8 to < 12 weeks                       | 14 (13.2%) |
|                        | 12 weeks or more                      | 22 (20.8%) |
|                        | missing                               | 11 (10.4%) |

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## Antibiotic knowledge and use

### Recent antibiotic use

32.1% of participants reported antibiotic use in the previous month and a further 23.6% in the preceding 6-12 months (Table 2). Most (61.3%) obtained antibiotics or prescriptions from a doctor or dentist; other sources included pharmacists (without prescription); friends and family; and saved antibiotics from a previous illness (Table 3).

*Table 2: Number and percentage of participants who reported using antibiotics in various time periods prior to the study.*

| Last antibiotic use    | N (%)      |
|------------------------|------------|
| In the last month      | 34 (32.1%) |
| In the last six months | 15 (14.2%) |
| In the last year       | 10 (9.4%)  |
| More than a year ago   | 10 (9.4%)  |
| Never                  | 9 (8.5%)   |
| I can't remember       | 23 (21.75) |
| Missing                | 5 (4.7%)   |

*Table 3: Number and percentage of participants who reported obtaining antibiotics from various sources. Percentages do not add to 100% because some participants reported more than one source.*

| Source                       | N (%)      |
|------------------------------|------------|
| Doctor/dentist               | 65 (61.3%) |
| Pharmacist (no prescription) | 19 (17.9%) |
| Online (no prescription)     | 2 (1.9%)   |
| Friend/family                | 10 (9.4%)  |
| Saved from previous time     | 7 (6.6%)   |
| Can't remember               | 10 (9.4%)  |
| Missing                      | 0 (0%)     |

### Antibiotic knowledge

On average, participants answered 30.2% of knowledge questions correctly (SD = 17.0%; see Online Resource 1 for responses to individual items). The range was wide (0.0% to 70.0%), partly because many participants answered *don't know* to many or all questions. 12 participants who answered *don't know* to 19 or 20 of 20 knowledge questions were excluded from further analyses involving this score to avoid confounding poor knowledge with non-engagement.

There was no evidence for differences in antibiotic knowledge between language groups ( $\chi^2(2) = 3.89$ ,  $p = 0.143$ ) or between levels of general health ( $W = 1000.5$ ,  $p = 0.559$ ). However, antibiotic

175 knowledge increased with both education level ( $J-T = 2006.5, p = 0.031$ ) and age ( $J-T = 1765.5, p =$   
176  $0.001$ ).

177 **Problematic Antibiotic Use**

178 All participants reported engaging in at least one problematic behaviour at least *sometimes*;  
179 61.2% reported doing so *very often or always* (Figure 1A). There was no evidence for decreasing  
180 problematic antibiotic use with increasing education level ( $J-T = 1816.5, p = 0.076$ ) nor with  
181 increasing age ( $J-T = 1601.5, p = 0.504$ ).

182 Problematic antibiotic use differed between different language groups ( $H(2) = 21.54, p < 0.001$ ).  
183 Post-hoc pairwise comparisons revealed significant differences in problematic antibiotic use  
184 between all three pairs: Arabic vs. Dari ( $p = 0.002$ ), Arabic vs. Pashto ( $p = 0.02$ ), Dari vs. Pashto ( $p$   
185  $< 0.001$ ), see Figure 1B.

186 Problematic antibiotic use also differed by general health ( $W = 1485.5, p = 0.018$ ); participants in  
187 the *very poor, poor or fair* group had a median antibiotic misuse score of 8 (IQR: 5.5-11.5),  
188 compared to a median of 6 (IQR: 3-10) in the *good or very good* group.

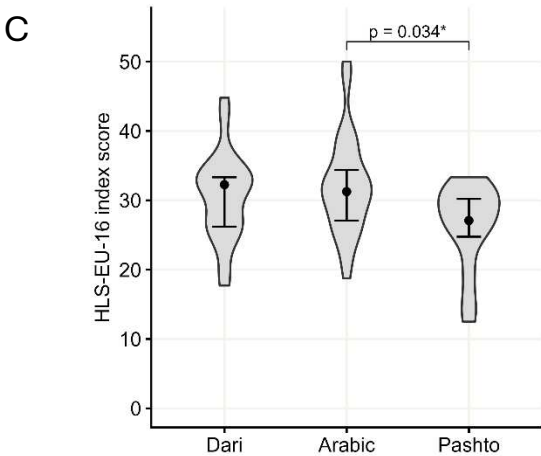
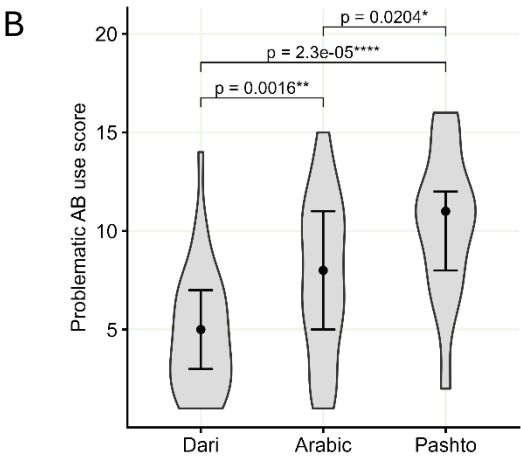
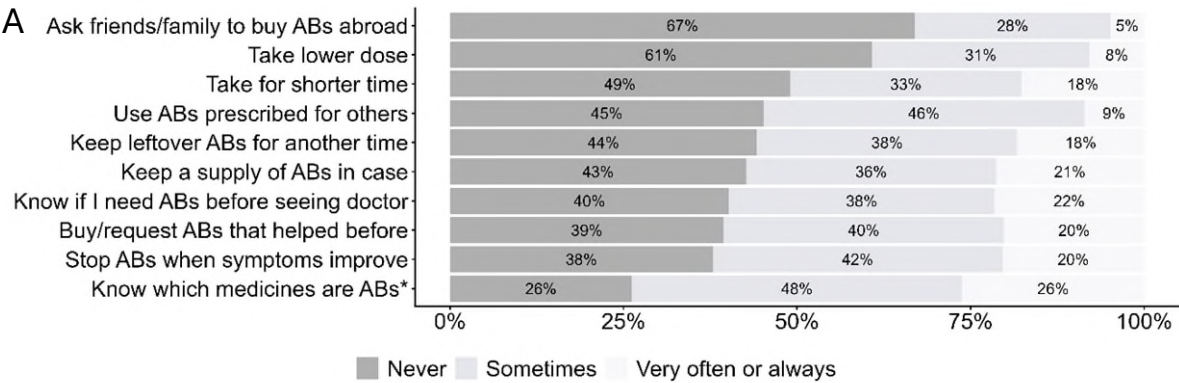


Figure 1 A. Stacked bar chart showing percentage of participants reporting that they never (dark grey), sometimes (mid grey), or very often or always (light grey) engage in problematic antibiotic use. \*Responses for the question “I know which medicines are antibiotics” were reverse-scored (never (dark grey), sometimes (mid grey), or very often or always (light grey)). B. Violin plots showing differences in self-reported problematic antibiotic use by language group; the median problematic antibiotic use score was significantly higher amongst Arabic speakers than Dari speakers and significantly higher amongst Pashto speakers than amongst the other two language groups. C. Violin plots showing the distribution of health literacy within each language group; the median HL index score was higher amongst Arabic speakers than amongst Pashto speakers. Points and whiskers represent medians and interquartile ranges; statistical significance of pairwise comparisons was calculated using two-sided Wilcoxon tests with Holm’s correction for multiple comparisons, \* = <0.05, \*\*\*<0.001. Values >0.05 were defined as non-significant and are not marked. AB = antibiotic, HL = health literacy

## Health literacy

The most common response for all HLS-EU-16 items was easy, though item-level differences were marked (Online Resource 2). Self-reported HL was *sufficient* for 51% of participants; *problematic* for 30.8%; and *inadequate* for 18.3%. A one-sample proportion test produced no evidence that the prevalence of *sufficient* HL was significantly different from that observed in a previous study with a representative German sample [37],  $p = 0.37$ , 95% CI [0.41, 0.61].

## Health literacy and demographic variables

There was no evidence that HL index score increased with increasing education (J-T = 2382,  $p = 0.059$ ) or age group (J-T = 1542,  $p = 0.689$ ). Nor did HL index differ significantly between general health groups ( $W = 1017.5$ ,  $p = 0.275$ ).

However, there was some evidence for differences in HL index between language groups,  $\chi^2(2) = 6.75$ ,  $p = 0.034$ , though the small subgroups mean that caution is warranted in interpreting this finding. Arabic speakers tended to have higher HL (median = 31.25, IQR = [27.08-34.38]) than Pashto speakers (median = 27.08, IQR = [24.76-30.21]),  $W = 569$ ,  $p = 0.034$ , Cliff’s  $\delta = 0.43$  (medium effect). The comparisons between the other pairs of language categories were non-significant (Figure 1C).

## Antibiotic knowledge, antibiotic use and health literacy

Problematic antibiotic use was negatively associated with both better antibiotic knowledge ( $p = -0.226$ ,  $p = 0.007$ ) and higher HL index scores ( $p = -0.249$ ,  $p = 0.012$ ). Moreover, the association between HL index scores and problematic antibiotic use remained significant after controlling for antibiotic knowledge (partial  $p = -0.284$ ,  $p = 0.007$ ,  $N = 90$ ), indicating that higher HL was associated with less problematic antibiotic use independently of antibiotic knowledge.

## Discussion

In our sample of refugees and asylum seekers, recent antibiotic use was common: around a third of participants had used antibiotics in the preceding month and over half in the preceding year. This exceeds rates in the general German population [12] but aligns with WHO multi-country survey data (35% previous-month prevalence) [24]. Rates of antibiotic use varies widely by country [24,38] and previous studies indicate that it is often considerably higher in refugees' home countries than in Germany [39]. We did not ask whether participant had obtained antibiotics in Germany or elsewhere, but the elevated rate converges with evidence of frequent, often clinically inappropriate, antibiotic prescribing for newly-arrived refugees and migrants in Germany [40].

Most participants (60.8%) reported obtaining antibiotics (or prescriptions) from a doctor or dentist – somewhat lower than the 81% reported in WHO multi-country survey data [24], possibly reflecting that survey's inclusion of nurses as a prescribing source. A minority obtained antibiotics from family or friends or had them saved, consistent high global rates of antimicrobial self-medication [7,41,42].

Antibiotic knowledge was patchy (mean score 30.2%); age and education, but not general health or language group, were positively associated with knowledge. Problematic antibiotic behaviours were widespread: all participants reported at least one such behaviour at least *sometimes* and around 60% reported at least one *very often or always*. This is concerning given the elevated risk of antibiotic resistant infection amongst refugees [4]. Notably, this occurred despite HL levels comparable to the German population, suggesting that problematic antibiotic behaviour may partly reflect other factors, such as health system norms in participants' countries of origin, where antibiotics are frequently available without prescription [6,43]. Such sociocultural influences may persist after migration, even when HL is adequate.

Turning from overall scores to specific items, we found patterns of knowledge gaps and misuse broadly similar in direction to those reported elsewhere, with some divergences. For example, only 29% correctly identified antibiotics' inefficacy against viral infections (34% incorrect, 37% *don't know*), which suggests larger knowledge deficit than reported in a recent global meta-analysis (54% incorrect [44]), or a German study (47% incorrect [25]). Stopping antibiotics early on symptom improvement (42% *sometimes*, 21% *very often/always*) was somewhat more common than globally reported rates (47%) [44]. Keeping leftover antibiotics for future use was considerably more common in our sample (58% *sometimes or very often/always*) than in prior German studies (~20% [12,25]).

About half of participants (51%) reported *sufficient* HL – a rate remarkably similar to that found in the general German population [37], suggesting that many refugees and asylum seekers arrive with a foundation of health-information related skills relevant to self-management and integration in the German healthcare system. Conversely, 30.8% of participants reported *problematic* and 18.3% *inadequate* HL, indicating that they face significant challenges accessing and understanding health information, similarly to comparable proportions of the German population.

These findings contrast with several Swedish studies using the same measure which estimated that around 62% of refugees have *inadequate or problematic* HL [21,23,45]. These discrepancies may arise from differences in sample characteristics (countries of origin, language, residency duration) or dissimilarities in the healthcare system and organizational HL of services involved in refugee healthcare.

We found some evidence for language-based disparities in both antibiotic use and HL: inappropriate use was lowest amongst Arabic speakers and highest amongst Pashto speakers and Arabic speakers had higher HL scores than Pashto speakers, though small subgroup sizes, especially for Pashto speakers, mean that these results should be considered exploratory. They nonetheless illustrate that linguistic and cultural factors may nuance both HL and antibiotic use and suggests not only that tailored HL interventions for specific linguistic and cultural subgroups may be needed, but also that specific (socio-)linguistic communities may be more vulnerable, justifying prioritisation for health promotion and both individual and organisational HL interventions [46].

Importantly, higher HL was associated with less problematic antibiotic use over and above the effect of knowledge, suggesting that antibiotic behaviour is not driven by knowledge alone. Although these associations cannot establish causality, they suggest that interventions targeting both low-HL and low-knowledge individuals may have the greatest potential to reduce inappropriate antibiotic use in this population. In addition, interventions to improve organisational HL in refugee healthcare services could be beneficial. These should account for prescribing norms and practices in participants' country of origin, since antibiotic behaviour that is considered inappropriate in the current context likely made sense in its original context [47,48]. Medical staff should be aware that use patterns in countries of origin may differ from host country norms in heterogeneous ways and should address knowledge gaps and misunderstandings in a culturally sensitive way, taking HL into account. Interestingly, a recent systematic review of HL interventions for refugees and migrants found only three studies focussing on refugees and none addressing infectious diseases or antibiotic use [46].

This study has several limitations. Small subgroups mean that caution is warranted in interpreting language findings; moreover, Arabic speakers came from several countries whereas Pashto and Dari speakers were mostly from Afghanistan with a small number from Iran. Small subgroup numbers also precluded more complex explorations, such as interactions between demographic factors. The predominantly male sample should also be borne in mind. Use of self-report measures is a further limitation. Nevertheless, this study provides valuable, real-world data on HL and antibiotic use amongst recently-arrived refugees and asylum seekers in Germany.

In conclusion, HL among LEA residents in Freiburg is broadly comparable to the German population. However, patchy knowledge and problematic use of antibiotics, possibly driven by cultural norms and unregulated medication practices in countries of origin, remain major concerns. There is an urgent need for evidence-based interventions to improve safe and effective use of antibiotics amongst refugee and asylum seeker populations, building on their existing HL. Heterogeneity in HL and antibiotic knowledge and use underscores the need for such interventions to be targeted to the specific needs of individuals and subgroups in order to effectively address knowledge gaps, inappropriate antibiotic practices, and antimicrobial resistant infections.

## List of abbreviations

|           |                                                                       |
|-----------|-----------------------------------------------------------------------|
| AMR       | antimicrobial resistance                                              |
| HL        | health literacy                                                       |
| HLS-EU-16 | European Health Literacy Survey Questionnaire (16 item version)       |
| LEA       | <i>Landeserstaufnahmeeinrichtung</i> (state initial reception centre) |

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