Tales of Treatment: How Local Voices and Public Engagement Activities can Shape Global Health Research and Policy

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Abstract

Global health champions modernism and biomedical knowledge but tends to neglect knowledge, beliefs, and identities of rural communities in low- and middle-income countries. The growing emphasis on public engagement offers an opportunity to broaden discourse and incorporate local knowledge in unprecedented ways, but this practice has so far fallen short of its potential.

Situated in the field of antimicrobial resistance (AMR, a global health priority), we present a case study of public engagement with research involving indigenous groups in Chiang Rai, northern Thailand. Drawing on content and feedback from a photography exhibition of traditional "Tales of Treatment," half-day public engagement workshops, and rural health behaviour surveys, we will:

- Analyse locally grounded research hypotheses.
- Interrogate assumptions about traditional healing and its relationship to AMR as a threat to modern medicine.
- Discuss the costs and risks of co-producing knowledge through public engagement activities with bi-directional forms of communication.

Our case demonstrates how local knowledge and traditional healing practices can add nuance to biomedical discourse and challenge persistent hierarchies of knowledge in AMR. We conclude that knowledge co-production should ultimately become a standard secondary objective of global health research, but it requires extensive evaluation to assess its benefits and risks comprehensively.

Keywords

Global health, public engagement, knowledge co-production, Thailand, antimicrobial resistance

Introduction

Global health research and practice have been – and are increasingly – criticised for their colonial roots, some of which are evident in the continued reproduction of a hierarchy of knowledge that subordinates rural populations in low- and middle-income countries (LMICs) to Western biomedical logic and local medical elites (Keller, 2006; Pratt *et al.*, 2018). Antimicrobial resistance (AMR) is an example of this tension between the "global" and the "local." A top priority item on the global health agenda, AMR involves the evolution of microbes like bacteria and viruses to withstand the medicine that humans use to treat them, thereby making them increasingly "drug resistant" and the medicine less effective. This is in principle a naturally occurring process, but humans accelerate it through the use of antimicrobials (antibiotics, antivirals, antifungals, etc.) in human and veterinary medicine, in agriculture, and through their leakage into the environment. The World Health Organization (WHO) Director-General has declared AMR as "one of the most urgent health threats of our time"[1] – parallel to the establishment of a dedicated organisational unit under an Assistant Director-General for antimicrobial resistance (WHO, 2019).

The global health response to AMR mirrors the biomedical interventionism with which post-colonial medicine has been characterised (Keller, 2006). Global policies to address AMR foreground individuals' behaviour as one of the principal problems of a subject that connects humans, animals, and the environment (Chandler, 2019).[2] The global response focuses accordingly on awareness and education campaigns to change population behaviour (The Review on Antimicrobial Resistance, 2016;

[1] This choice of words reflects a broader discourse around AMR that mobilises apocalyptic – and in many instances neoliberal economic – narratives (Brown & Nettleton, 2018; Chandler, 2019).

[2] In the area of antimicrobial use for human health, other problem areas include, for example, public hygiene and disease prevention, regulated access to medicines, disease diagnosis, or market conditions for the development of new antimicrobials (MacDougall & Polk, 2005; The Review on Antimicrobial Resistance, 2016:19-20; WHO, 2015b).

WHO, 2015b), implying that knowledge and practices that deviate from a Western biomedical rationale – for instance care from traditional healers during an illness – are problematic and require rectification (Gualano *et al.*, 2015; Haak & Radyowijati, 2010).

But AMR is also a field in flux. Through the conceptualisation as a "one health" problem that spans human, animal, and environmental health, a corresponding global "tripartite collaboration" involving the World Health Organization, the Food and Agriculture Organization of the United Nations (FAO), and the World Organisation for Animal Health (OIE) was established to govern AMR (Rochford *et al.*, 2018). Arguably through increasing interdisciplinary collaboration, global health narratives are also gradually beginning to add nuance to the individual-focused approach to behaviour change (WHO, 2017; WHO *et al.*, 2018). In addition, the growing emphasis on "public engagement" among health researchers and funders offers an opportunity to break down (or at least undermine) hierarchical relationships between medical elites and local populations (Cohen *et al.*, 2008; Hamlyn *et al.*, 2015; Research Councils UK, 2011; Wilson *et al.*, 2014).[3]

Alas, as we argue in this paper, the global health response to AMR continues to champion biomedical knowledge and to neglect or otherwise subordinate the knowledge, beliefs, and identity of rural communities in LMICs. Public engagement activities, rather than breaking up this hierarchy, have thus far primarily been instrumentalised to impose this agenda on local populations (e.g. through theatre plays; Redfern *et al.*, 2018). In this article, we will therefore examine a case study of knowledge co-production embedded in the public engagement activities of an interdisciplinary research project on health behaviour and AMR. Our research question is, "*Can knowledge co-production in global health research challenge hierarchies and promote engagement?*"

[3] Also referred to as "community engagement," "patient and public involvement" (PPI) in research, or in some instances also as participatory research (Brett *et al.*, 2014; Darroch & Giles, 2014; Staniszewska *et al.*, 2017; Tindana *et al.*, 2007).

Background

Research on population health behaviour in AMR mobilises conventional public health research methods. We review these methods in this section and argue that they risk reproducing a hierarchical relationship which subordinates local medical knowledge and traditional forms of healing in LMICs to the biomedical model of health that is prominent in high-income countries and among local medical elites (Pelto & Pelto, 1997; Sudhinaraset *et al.*, 2013).

As with standard public health research, a cornerstone of AMR knowledge generation are public awareness surveys and knowledge, attitude, and practice (KAP) surveys. For example, one of the most influential documents in the context of awareness-related global AMR policy is the WHO's *Antibiotic resistance: multi-country public awareness survey* (Tangcharoensathien *et al.*, 2018; WHO, 2015a). Based on online and face-to-face surveys in 12 countries and using a range of knowledge testing questions, the survey argues that, "it is critical that people understand the problem [of drug resistance], and the way in which they can change their behaviour" (WHO, 2015a:42). Another recent example is the study by Muri-Gama *et al.* (2018), who carried out a representative survey of rural dwellers in the Amazon Basin in Brazil. The authors argue that, despite the remoteness of their field sites, "15% of the population had taken an [antimicrobial], two-thirds of them without prescription and, even worse, in one-third of cases this was used to treat non-infectious or non-bacterial symptoms or conditions" (Muri-Gama *et al.*, 2018:4). Aside from public awareness surveys, the specific instrument of KAP surveys is similarly prominent in the field of public health AMR research (Gualano *et al.*, 2015), including (with a focus on antibiotics) contexts as diverse as the studies by Belongia *et al.* (2002) on patients' antibiotic use for respiratory illnesses in the United States, by Yu *et al.* (2014) on parental antibiotic use for their children in China, or by Awad and Aboud (2015) on the general public's antibiotic use in Kuwait.

Public awareness and KAP surveys as mainstream tools for global health knowledge generation typically conclude that awareness needs to be raised, and call on individuals' responsibility to change

antimicrobial-related health behaviours (Chandler, 2019; Chang *et al.*, 2018; Gualano *et al.*, 2015; McCullough *et al.*, 2016). A major problem of these approaches is that the problem of antimicrobial use is framed in terms of knowledge and attitudes (thus proposed solutions tend to focus on exactly these domains, reminiscent of the "law of the tool"),[4] and the notions of what constitutes "desirable knowledge" are typically imposed by the health researchers with an implicit superiority of modern over local and traditional forms of knowledge (Launiala, 2009). Yet, such studies devote little if any concern towards the social and ethical antecedents of current behaviour (and the corresponding consequences of intervention) in LMICs, for instance the historical role of drug promotion or the precarious balance between antimicrobial "access and excess" (Das & Horton, 2016; Haenssgen *et al.*, 2018a; Olivier *et al.*, 2010).

In contrast, recent social sciences and interdisciplinary research on AMR has pointed out non-individual components of antimicrobial use. For example, Chandler (2019) describes, among others, the interconnectedness of AMR across the domains of human, animal, and environmental health and the social role of antimicrobials as "infrastructure" that contributes to the functioning of market economies; Hinchliffe *et al.* (2018) indicate how Bangladeshi shrimp and prawn farmers adapt their antimicrobial use in response to economic uncertainty and perceived disease risks; and Chuengsatiansup and Limsawart (2019) analyse the tensions between administratively defined borders and their history, enactment, and continued negotiation in the control of drug-resistant tuberculosis in the border area of Thailand and Myanmar. Although global health narratives are gradually beginning to add nuance to the individual-focused approach to behaviour change (WHO, 2017; WHO *et al.*, 2018), the biomedical discourse around AMR continues to portray a hierarchical relationship between Western high-income countries' priorities and solutions, LMICs as source of a global problem, and

[4] "I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail" (Maslow, 1966:15).

individuals' knowledge and behaviour as critical targets for intervention (Khan *et al.*, 2019; Wernli *et al.*, 2017).

In the absence of social theory to guide public health research, exploratory qualitative research or participatory research methods could offer an avenue to challenge the mainstream framing of AMR and the implied hierarchy of medical knowledge and practice. However, unlike interdisciplinary or social sciences qualitative research, qualitative research in public health often remains limited to examining people's attitudes and knowledge akin to public awareness surveys (Hawkings *et al.*, 2007; McCullough *et al.*, 2016; Muri-Gama *et al.*, 2018). Similarly, "participatory methods" or "public engagement" in public health research are typically instrumental means with an emphasis on health education provision, on "mobilising" communities to change their health behaviour, and/or on building trust and legitimacy of health research locally (Allison *et al.*, 2017; Davis *et al.*, 2017; Howard *et al.*, 2013; Lim *et al.*, 2016; Nyirenda *et al.*, 2018; Redfern *et al.*, 2018; Roh *et al.*, 2018; Tindana *et al.*, 2007).

Qualitative research and public engagement involving the co-production of knowledge with inputs from the target populations have been argued to broaden understanding and open new directions for debate (Keikelame & Swartz, 2019; Moodley & Singh, 2016). In public health and global health research, these methods have a tendency to retain biomedical assumptions, to fall short of their potential to challenge hierarchies of knowledge, and to reproduce neo-colonial relationships in global health (Abimbola, 2019; Keikelame & Swartz, 2019). Our article therefore aims to demonstrate how public engagement in AMR can inform global health research and practice more constructively.

Material and methods

Case overview

This article describes the case of the "Antibiotics and Activity Spaces" research project (Haenssgen *et al.*, 2018b), in which knowledge co-production took place through workshops in three villages and through the collection and exhibition of photographic stories of healing in Chiang Rai province in northern Thailand. The three villages were located in the districts of Mae Fah Luang, Chiang Rai, and Chiang Khong of Chiang Rai province.

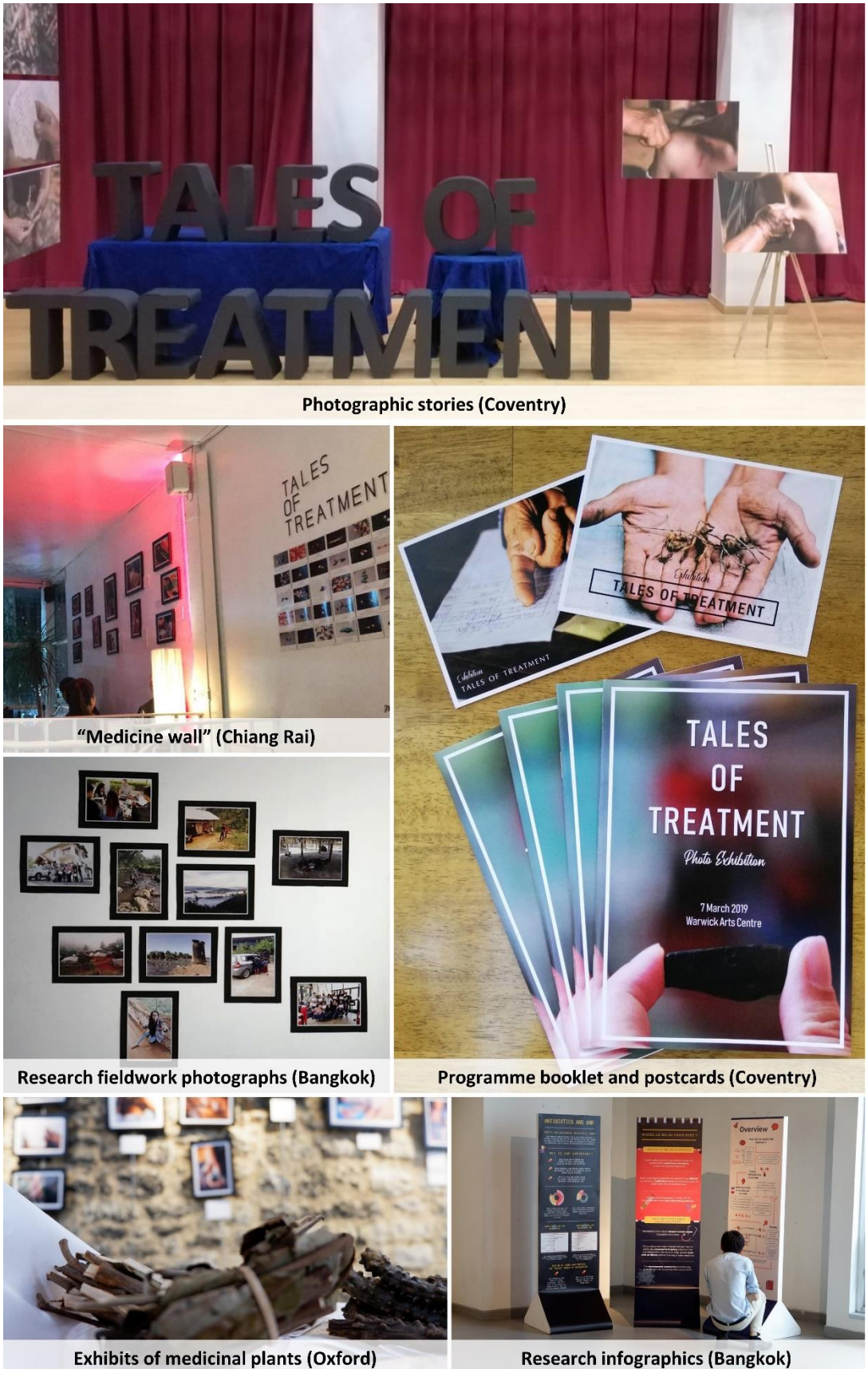
The workshops took place in the context of rural health behaviour surveys and had two objectives: first, to share with villagers some ideas and concepts about antibiotics and drug resistance, without assuming that their current knowledge and behaviours are in any way deficient; second, to enable our research team to learn from the villagers about the local context of medicine and healing and how the antibiotic-related information has been received. The half-day workshops involved 20 to 35 adults per village, who were recruited in a combination of purposive and snowball sampling to ensure spatial and ethnic diversity of the participants (however, all attendees had Thai language abilities, which limited the representativeness of the workshops). The workshop activities involved, in chronological order,

1. an ice-breaking activity to create an open and positive atmosphere,
2. the development of a community map to represent different types of healthcare providers,
3. a pile sorting activity to understand conceptions and categories of medicines,
4. a drug-resistance-themed chair game to illustrate the evolution of bacteria,
5. a traditional pop song with adapted lyrics to illustrate WHO messages to seek advice from medical practitioners,
6. a role-playing activity to illustrate the relationship between antibiotic use and drug resistance, and

7. a poster-making activity as a feedback mechanism and to understanding participants' interpretations of the workshop content (see Charoenboon *et al.*, 2019, for a detailed description of the workshops).

The workshops took place alongside larger health behaviour surveys in Chiang Rai. During the surveys, regular review and reflection meetings with the team of field investigators also revealed that, although the questionnaire captured treatment-seeking sequences in an extensive (and time-consuming) manner, the ensuing quantitative data would not be able to capture important aspects of local healing. While the project surveyed 72 villages in Chiang Rai, the team shared experiences of herbalists curing broken bones and spiritual healers summoning ghosts. What was the meaning and significance of these practices, and what would the corresponding survey data point "traditional healer" mean for villagers? To investigate these questions further, the research team and fieldworkers revisited some of the villages to document stories of healing that our participants permitted us to share. The resulting narratives were exhibited in the "Tales of Treatment" photo exhibition series in Bangkok (Art Gallery 23), Chiang Rai (Tai tea shop and bar), Oxford (Green Templeton College), and Coventry (Warwick Arts Centre) between July 2018 and March 2019. The content of the exhibitions varied slightly by location (considering available space and logistics; see Fig. 1 for illustrations) and included:

- 15 photographic stories with Thai/English captions and guided tours by the research team (all four exhibition sites)
- Exhibits of pharmaceuticals and medicinal plants (Bangkok, Chiang Rai, Oxford)
- "Medicine wall" of pharmaceutical images and local notions of medicines (Bangkok, Chiang Rai, Oxford)
- Programme booklets and souvenir postcards (Coventry)
- Research fieldwork team photographs (Bangkok, Oxford)
- Research infographics, word clouds, and/or animated presentations (Bangkok, Chiang Rai, Oxford)



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197 *Fig 1. Impressions of "Tales of Treatment" exhibition elements.*

198 Source: Authors.

Data collection and analysis[5]

This article uses primary qualitative and quantitative data to document and explore how knowledge co-production challenged not only our own expectations as survey researchers but also contributed to new perspectives on global health.

To investigate the contributions of the workshops, we first formulated hypotheses based on the direct inputs from participants, which we documented as observational data. These hypotheses were tested using the primary quantitative data from the rural health behaviour surveys of the "Antibiotics and Activity Spaces" project. The survey data involved (a) two rounds of complete adult census surveys in the three workshop villages (in between which the workshops took place), and (b) a provincial-level representative rural health behaviour survey (using a three-stage stratified random sampling design). As shown in the questionnaire (see supplemental material), the surveys collected data on the individual level (e.g. demographic attributes, knowledge and attitudes regarding antibiotics and drug resistance), illness level (treatment-seeking sequences among the respondents and/or children under their supervision, and healthcare choices within these sequences), and the step level (e.g. which kinds of medicines the respondent received and used at each step of the illness process). Aside from the sampling strategy, the two surveys were largely identical with the exception of information on social networks and the workshops, which was only collected in the census surveys. For the quantitative analysis, we first applied the hypotheses to the village(s) where they arose, then to all three workshop villages (using the first or both survey rounds depending on whether data analysis took place on the

[5] The research was reviewed and approved by the University of Oxford Tropical Research Ethics Committee (Ref. OxTREC 528-17), and it received local ethical approval in Thailand from the Mae Fah Luang University Research Ethics Committee on Human Research (Ref. REH 60099). The service evaluation of the photo exhibition involved anonymised data collection and received a waiver for ethical approval from the University of Warwick Humanities & Social Sciences Research Ethics Committee (HSSREC). However, all evaluation form respondents explicitly consented to the data being reported in research publications.

individual or illness level),[6] and subsequently to the representative sample of rural Chiang Rai province. We analysed the data descriptively, comparing responses across groups and, where appropriate, performed Pearson X^2 tests to test whether these differences were statistically significant.

For the photographic stories and exhibitions, we first drew on a selection of photographic and narrative stories from villagers in northern Thailand (documented by research survey team) to reflect on implicit assumptions embedded in the "Antibiotics and Activity Spaces" project and to inform the understanding of antibiotic resistance as a global health priority. These narratives were subsequently presented at the "Tales of Treatment" exhibition (the full set of stories can be accessed at https://tinyurl.com/talesoftreatment). Drawing on verbal and written feedback from the photo exhibitions (the latter collected through evaluation forms), we reflected further on audience reactions and the potential impact of the public engagement activity. Note, however, that none of the data collection and analysis methods presented here constitute a formal evaluation of the workshops and exhibitions.

Results

This section separately reports on the knowledge co-production workshops and storytelling activities, using observations from co-production and engagement activities, primary survey data, and event feedback. The results demonstrate how insights and reflections sparked by the direct input from research populations and through the engagement of the public can broaden debates and viewpoints within the field of global health. However, the results also hint at the limitations and potential risks of a co-production approach. We discuss these limitations together with the costs and benefits of the co-production activities in the subsequent section.

[6] Data on the individual level would entail duplication of observations should both census survey rounds be included. Step-level data was aggregated on the illness level for analysis.

Co-production workshops

The first domain of knowledge co-production considered in this case study were the workshops hosted in three Chiang Rai villages. We report elsewhere the impacts resulting from the workshops on people's health behaviour (Charoenboon *et al.*, 2019; Haenssgen *et al.*, 2018c). In this section, we explore in three examples from a medicine pile sorting activity how the interactions between the research team and the workshop participants helped shape our understanding of medicine use in rural Chiang Rai. More specifically, the pile sorting activity helped us to generate new hypotheses about the relationships between the local social context, notions of medicine, and treatment-seeking behaviour – in a way that we as research team did not initially consider in our research design. We illustrate the significance of the participant-based hypotheses through the analysis of primary survey data.

Antibiotics you can buy

Our first example involved participants in the Mae Fah Luang village workshop, who described how they categorise different types of antibiotics into the groups "you can buy this medicine over the counter" and "you need a prescription from a doctor to obtain this medicine." These categories related directly to global health awareness campaigns, as for instance the World Health Organisation (WHO) advocates that antibiotics should only be used "when prescribed by a certified health professional" (WHO, 2016). Based on the input from the villagers, we therefore hypothesise that,

H1: Villagers' attitudes towards buying antibiotics over the counter differ depending on the types of antibiotics that they recognise.

Our survey questionnaire did not specifically classify individual types of antibiotics into the categories of "can buy" and "cannot buy." However, we gathered information about the terminology that people use when they refer to common antibiotics in circulation, and whether they are familiar with common colloquial names for antibiotics as "anti-inflammatory medicine" ("*ยาแก้อักเสบ*" or "*yah kae ak seb*"). Subsequently, we asked a range of knowledge and attitude questions corresponding to antibiotic

awareness-raising material from the WHO, including whether there are situations in which the respondent would buy antibiotics (or however else they would interpret the medicine) over the counter – "desirable" responses being those that fell in line with the WHO position, meaning that the respondent would not buy this medicine without a prescription.[7] If the hypothesis holds, then we would thus expect to see different attitudes to over-the-counter antibiotic purchases depending on how the respondents refer to the medicine.[8]

In the Mae Fah Luang village, relatively fewer people (Table 1) referred to antibiotics with the colloquial name "anti-inflammatory," which, however, dominated the range of local notions in general. Owing to the ethnic diversity of the Mae Fah Luang village, several local language descriptions unbeknownst to us circulated alongside notions like "germ killer," capsule medicine, cough medicine, pain reliever, or vernacularized generic antibiotic names like "*amoxi*" (for amoxicillin) and "*colem*" (for chloramphenicol). Also a relatively large share of people (14.8% vs. 10.3% on the provincial level) recognised images of the antibiotic capsules but did not know what they were called.

[7] The "desirability" of the responses was field coded by the survey team. Sample responses (as instructed through the survey manual) for "desirable" answers included, "No, I don't buy those," "Only if the doctor says that I should," or "Why would I buy it?" Sample responses for "undesirable" answers included "Yes, you can buy it in the shop over there!," "I haven't bought it, but why not?," or "Only for a sore throat, not otherwise." Note that the wording of "desirable" and "undesirable" here pertains only to the extent to which the responses align with WHO positions – we do not make a judgement here whether the responses are appropriate from the respondents' perspective. Because of post-survey binary recoding, the variable should be interpreted as "the fraction of respondents who uttered a 'desirable' response" – the inverse is therefore not the share of "undesirable" responses but rather the fraction of responses that could not be deemed "desirable" (e.g. "don't know" or "no opinion").

[8] For the workshop villages, we only include the first survey round to avoid double-counting of responses.

Table 1. Top 10 responses to describe pictures of common antibiotics used in Chiang Rai province, and the corresponding share of respondents that would refrain from buying the medicine over-the-counter ("desirable" attitude).

Rank	Mae Fah Luang Village (1st survey round; *n* = 155)			All Three Workshop Villages (1st survey round; *n* = 497)			Rural Chiang Rai Province (*n* = 1098)		
	Name	Mentioned	"Desirable" Attitude	Name	Mentioned	"Desirable" Attitude	Name	Mentioned	"Desirable" Attitude
1	Anti-inflammatory	70.3%	48.6%	Anti-inflammatory	72.4%	53.6%	Anti-inflammatory	86.4%	55.0%
2	Other (unknown) names	25.8%	70.0%	Other (unknown) names	26.8%	53.4%	Don't know the name of this medicine	10.3%	73.5%
3	Don't know the name of this medicine	14.8%	65.2%	Don't know the name of this medicine	12.7%	65.1%	Germ killer	10.3%	55.0%
4	Germ killer	7.1%	72.7%	Germ killer	5.0%	72.0%	Antibiotics	7.0%	67.9%
5	Capsules / medicine in general	5.8%	77.8%	Capsules / medicine in general	3.8%	52.6%	Heromycin, TC-Mycin, etc.	5.6%	39.4%
6	Amoxi (amoxicillin)	3.2%	80.0%	Colem (chloramphenicol)	3.0%	26.7%	Colem (chloramphenicol)	4.8%	42.4%
7	Cough medicine	1.9%	33.3%	Pain reliever	2.4%	58.3%	Capsules / medicine in general	4.6%	46.4%
8	Pain reliever	1.9%	66.7%	Antibiotics	2.2%	81.8%	Colour reference	3.1%	27.3%
9	Colem (chloramphenicol)	1.9%	33.3%	Amoxi (amoxicillin)	1.2%	83.3%	Pain reliever	2.5%	52.3%
10	Antibiotics	1.3%	100.0%	Cough medicine	1.0%	40.0%	Other non-antibiotic medicine	1.7%	24.8%

Source: Authors, derived from survey data.

Notes. Only including respondents who recognised the medicine shown. Multiple mentions per respondent possible. Provincial-level results are population-weighted using census data.

The column "'desirable' attitude" in Table 1 provides further information as to whether people's attitude to buying over-the-counter antibiotics aligned with WHO positions, depending on how the respondent interpreted the medicine presented to them. Because respondents could mention several different interpretations at once, and because the interpretations themselves are likely correlated with respondents' personal characteristics (e.g. ethnic background, language ability, education), these data do not map exactly onto the hypothesis and should be interpreted with caution. However, a trend appeared to emerge in which the technically correct interpretation of antibiotics was associated with a relatively high share of "desirable" attitudes to not buy the medicine over the counter without prescription. Curiously, yet consistent with Hypothesis 1, different vernacularized antibiotic names were linked systematically to very different attitudes, for instance "*colem*" was linked to levels of "desirability" ranging from 26.7% (all workshop villages) to 42.4% (provincial survey), whereas the "desirability" of responses involving "*amoxi*" ranged from 65.4% (provincial survey, not shown) to 83.3% (all workshop villages). More generally, respondents' attitudes towards over-the-counter purchases varied strongly across the Top-10 interpretations from 33.3% to 100.0% (Mae Fah Luang), from 26.7% to 83.3% (all workshop villages), and from 23.7% to 73.5% (provincial survey).

Although the specific categorisation was not captured in the survey questionnaire, and although the patterns were indicative rather than conclusive, the data provided circumstantial evidence in support of Hypothesis H1, namely that different names given to antibiotics were linked to different attitudes about antibiotic purchases. Future research could incorporate this aspect more systematically to understand which antibiotics villagers may be more inclined to procure over the counter – regardless of whether they have a biomedical understanding of antibiotic medicine.

Prescription medicine for children

Our second example pertains to a response that we encountered both in the Mae Fah Luang village and in the Chiang Rai village. We learned that villagers categorised medicine into "medicine for adults"

and "medicine for children." According to the workshop contributions, people would be extra careful with "medicine for children," follow instructions closely, and indeed only receive it against prescription, whereas the participants would buy "medicine for adults" for themselves over the counter. Antibiotics fell into both categories, which led us to hypothesise that,

H2a: If children receive antibiotics, these antibiotics are more likely to originate from formal healthcare providers.

H2b: If children receive antibiotics, these antibiotics are more likely to be used in accordance with their instructions.

The surveys elicited healthcare pathways during an acute illness or accident within the two months prior to the survey interview – both for the respondents and for children under their supervision. At each step of the process, the respondent could indicate whether any medicine was received, whether it was taken in line with the instructions received, and whether the medicine was finished. Because recalled descriptions of medicine tend to be ambiguous, we limited ourselves in our analysis to medicines where we had a high degree of certainty that they were an antibiotic. To operationalise these data for the hypothesis, we considered (a) illness episodes where at least one antibiotic had been received as a course or individual capsules, (b) whether these antibiotics originated from formal (public or private clinics and hospitals as well as pharmacies) or informal sources (e.g. grocery stores selling medicine, traditional healers), (c) whether in at least one instance the received antibiotics were not finished, and (d) whether in at least one instance the respondents maintained that they strictly adhered to instructions received (implying that instructions were received or otherwise provided on the medicine packaging). We examined these factors initially for the two workshop villages where these statements originated (focusing on the first survey round prior to the workshop), and then expanded the analysis to the full sample of illness episodes in both the workshop villages and the provincial survey. To test whether these differences were statistically significant, we performed Pearson X^2 tests.

The results of the analysis are presented in Table 2. Adults consumed antibiotics in 12.2% to 19.2% of all recorded illness episodes, whereas children's antibiotic consumption was slightly more frequent and ranged from 13.2% to 24.5%. Within these episodes of antibiotic use, the sources of children's antibiotics were systematically more likely to include formal healthcare providers, whereas adults were systematically more likely to use antibiotics from informal sources. The Pearson X^2 tests indicated that use of antibiotics from formal sources was statistically significantly different between adults and children at least at the ten percent level (Mae Fah Luang & Chiang Rai: $p = 0.070$; all workshop villages: $p = 0.041$, provincial level: $p = 0.083$). The difference in informal antibiotic use, too, was statistically significant, except in the provincial level data (Mae Fah Luang & Chiang Rai: $p = 0.070$; all workshop villages: $p = 0.088$, provincial level: $p = 0.235$). In contrast, none of the differences in completing antibiotic courses or adhering to instructions were statistically significant for any of the three samples.

Table 2. Comparison of adults' and children's antibiotic sources and use during acute illnesses and accidents.

	Mae Fah Luang and Chiang Rai Villages (1st survey round)			All Three Workshop Villages			Rural Chiang Rai Province		
	Adult	Child	*p*-Value	Adult	Child	*p*-Value	Adult	Child	*p*-Value
	All illness episodes								
Number	229	68		697	168		696	156	
% received antibiotics	12.2%	13.2%	0.825	14.3%	16.7%	0.447	19.2%	24.5%	0.321
	All antibiotic use episodes								
Number	28	9		100	28		125	31	
% of antibiotic use episodes received from formal sources	71.4%	100.0%	0.070	75.0%	92.9%	0.041	83.6%	100.0%	0.083
% of antibiotic use episodes received from informal sources	28.6%	0.0%	0.070	26.0%	10.7%	0.088	18.3%	6.1%	0.235
% of illness episodes with at least one instance of unfinished antibiotics	42.9%	44.4%	0.933	40.0%	39.3%	0.946	36.5%	48.6%	0.338
% of episodes with at least one instance of strict adherence to antibiotic instructions	64.3%	77.8%	0.452	67.0%	67.9%	0.932	72.2%	70.8%	0.908

Source: Authors, derived from survey data.
Notes. Data on illness episode level. Multiple illness episodes per respondent possible. Provincial-level results are population-weighted using census data. *p*-values calculated using Pearson X^2 test.

Larger samples would enable more precise estimates of the differences between adults and children. At this stage, we could only discern a relationship between children's illness episodes and the source of their antibiotics, which was more likely to be a formal healthcare provider. We therefore observed evidence that children were indeed more likely to receive antibiotics from formal healthcare providers, which is consistent with Hypothesis H2a. Interestingly, however, even the point estimates of the indicators of antibiotic use (finishing the course, adhering to instructions) were in several instances *worse* for children. With the limited evidence available to us in this study, however, there was no indication that the distinction between medicine for adults and medicine for children translated into stricter adherence to antibiotic use instructions (H2b). However tentative, these findings could contribute to the understanding of antibiotic use (and the identification of priority or high-risk target groups) in different segments of the population.

Assertive youth

Our last example, too, pertains to demographic differences in medicine use. In the Chiang Rai village, workshop participants reported that young adults would more commonly engage in arguments and assert their position vis-à-vis figures of authority, like doctors or elders. Although this may be generic judgement of older towards younger generations (Aristotle, 1954:Book II, Part 12), older people also had become acquainted in their youth with a health system that presented itself very differently from today's setup. This raised the question whether age gradients may reflect different patient – health system relationships across generations, and with them different patterns of antibiotic use. Similar to the difference between adults' and children's illness episodes, we therefore hypothesised that,

H3a: Younger adults are more likely to source antibiotics from informal healthcare providers.

H3b: Younger adults are less likely to use antibiotics in accordance with their instructions.

To test these hypotheses, we again examined first the initial survey round from the Chiang Rai village, followed by the complete workshop village sample and the complete provincial-level data. We used

the same indicators as in the previous section, namely the fraction of antibiotics received from formal and informal healthcare providers, and whether these antibiotics remained unfinished or were used in accordance with their instructions. We analysed the differences across five age groups, namely 18-24, 25-34, 35-44, 45-59, and 60+ years, using Pearson X^2 tests to test differences across age groups.

Fig. 2 presents the results of the group comparison (see Appendix Table A1 for detailed results incl. Pearson X^2 tests). The analysis of the Chiang Rai village was hampered by the small sample (17 illness episodes involving antibiotic use in the first survey round), owing to which we focused on the larger samples for the workshop villages (100 episodes) and the provincial survey (156 episodes). Within the sample of workshop villages, the age group 35-44 years exhibited the highest degree of formal antibiotic use (84.2%; sample average: 75.0%) coupled with the lowest incidence of informal antibiotic consumption (15.8%; sample average: 26.0%), the lowest rate of leaving antibiotics unfinished (21.1%; sample average: 40.0%), and the highest rate of adherence to antibiotic instructions (78.9%; sample average: 67.0%). Both younger and older age groups' data indicated higher informal use and less strict adherence to antibiotic regimes (both in terms of completing the course and following explicit instructions). However, only the group difference in terms of leaving antibiotics unfinished was statistically significant at $p = 0.020$. While the age group differences were in most cases statistically significant in the provincial sample (formal antibiotic use: $p = 0.007$; informal antibiotic use: $p < 0.001$; unfinished antibiotics: $p = 0.389$; adherence to instructions: $p = 0.002$), the patterns across age groups were distinctly different from the three-village sample where we conducted the workshops. The age group standing out in the provincial sample was 25-35 years, who had notably below-average formal antibiotic use (56.9%; sample average: 86.9%), above-average informal antibiotic use (54.9%; sample average: 15.9%), and below-average adherence to instructions (32.9%; sample average: 71.9%). The younger age group of 18-24 years, however, did not follow this trend and mostly corresponded to the remainder of the sample.

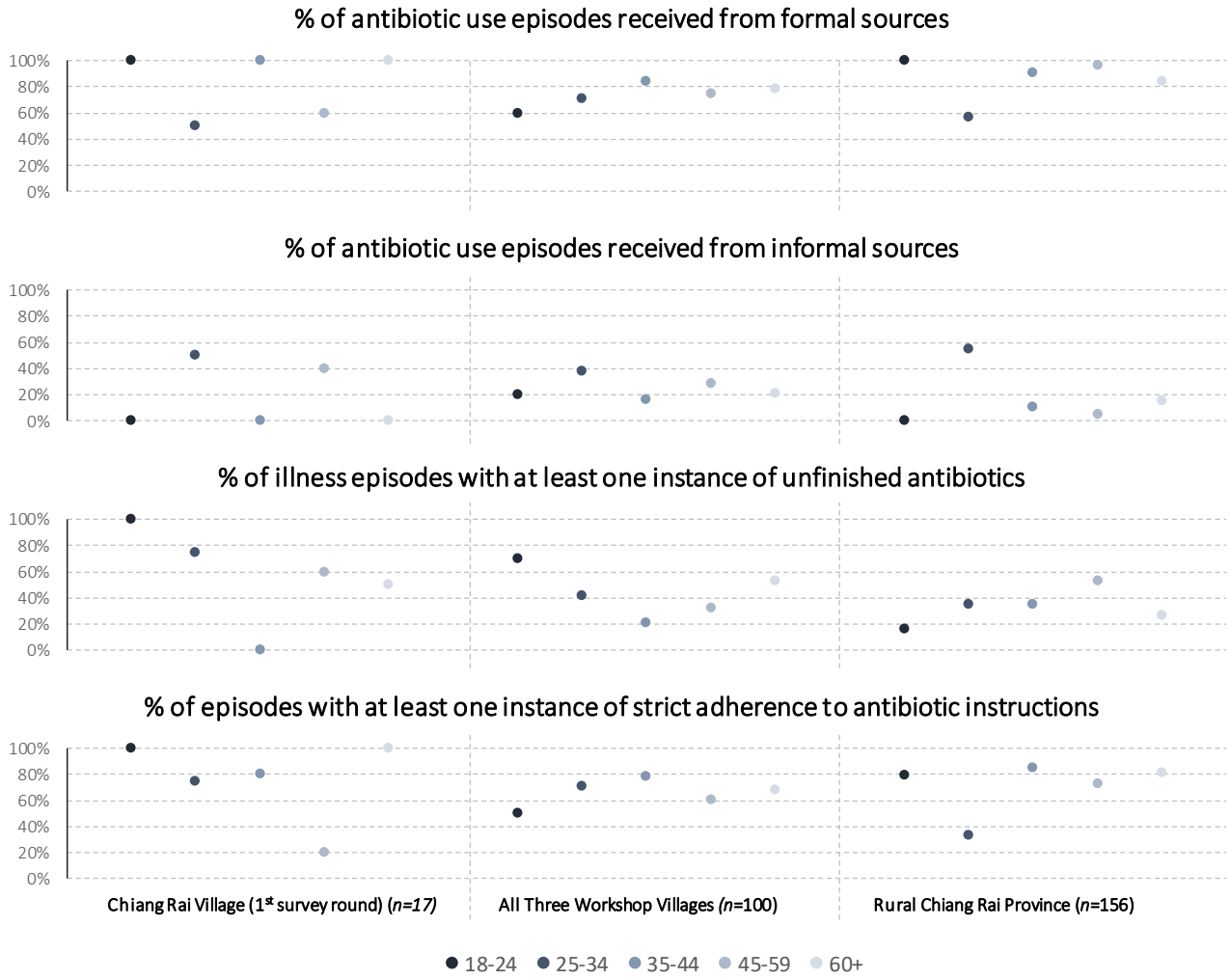

Fig. 2. Comparison of antibiotic sources and use during acute illnesses and accidents across five age groups.

Source: Authors, derived from survey data.

Notes. Data on illness episode level. Multiple illness episodes per respondent possible. Provincial-level results are population-weighted using census data.

Overall, the small sample did not permit a detailed examination of the Chiang Rai village. While the results in the larger workshop village sample and provincial sample were mixed, there was isolated indication that younger age groups exhibited less formal antibiotic use and less compliance than the mid-ranging age group of 35-44 years. The mixed patterns across the samples suggest caution in supporting or rejecting the hypothesis, but the data did suggest that antibiotic use behaviour was likely to have an age dimension. Further qualitative research would allow us to investigate whether these patterns related to different age groups' assertiveness (e.g. driven by formal education) as argued in

409 the workshops, or whether they were a result of different meaning and interpretations of medicines
410 across generations.

411 ***Storytelling and photo exhibitions in Thailand and UK***

412 The second domain of knowledge co-production that we consider in this article is a series of exhibitions
413 across Thailand and the UK in which we narrated photographic stories of treatment and healing in
414 northern Thailand. We use this example to illustrate how local stories did not only expand our
415 understanding of health behaviour and global health issues, but also how the engagement with these
416 stories led the broader urban public to reflect about healing and medicine.

417 *Stories of healing and treatment from northern Thailand*

418 This section presents a selection of the stories narrated in the Tales of Treatment exhibition to illustrate
419 insights about local healing and reflections on global health that would not otherwise have emerged
420 from the "Antibiotics and Activity Spaces" project. The stories did not intend to present superior or
421 effective forms of treatment but rather to chronicle disappearing narratives and practices of healing in
422 Chiang Rai.

423 Box 1 presents such a narrative from a traditional "ghost doctor" (i.e. a spiritual healer) in a Mien
424 village. The tale told of sacred books of chants in traditional Chinese, which in their entirety were often
425 only accessible to ghost doctors who learned their craft over generations.[9] However, minor chants and
426 small ceremonies were not reserved exclusively to the ghost doctor – it was a common skill in the
427 Mien village, applied for instance when teenagers sought forgiveness from their parents. The lessons
428 that this tale offered the team were two-fold: Firstly, the boundaries of "treatment" extended beyond
429 our initial (biomedically shaped) conceptions of what the roles of a traditional healer and spiritual care

[9] Perhaps obvious for some, one would not recite these chants and summon spirits without an actual ailment.

might involve. How could such practices like asking for forgiveness be incorporated into a standardised survey instrument on treatment seeking, and how might the omission of, for example, pastoral dimensions of care distort the representation of local realities? Secondly, the fluid interpretation of who was a ghost doctor in a village (i.e. potentially everyone) undermined our initially binary distinction between the general population versus medical providers.

Ghost Doctor Village

In Mien tradition, a "ghost doctor" is someone who performs ceremonies to chase away wickedness, to ask spirits for forgiveness, and to treat illnesses for people in the village. Mien people still hold on very strongly to spiritual beliefs that are embedded in their everyday life practices. That is why the ghost doctor profession is necessary in every Mien village. Some ghost doctors study the craft by themselves, some received the erudition from previous generations. For ceremonies, ghost doctors sometimes need to use a scripture written in Chinese to chant and cast charms correctly. One of the ghost doctors whom we talked to told us that many households in the village own scriptures similar to his, but not many people can read and remember everything. Because it is a specific set of language and characters, not everyone who can read Chinese will be able to read these books. Only skilled ghost doctors can execute all kinds of ceremonies while other people can only hold their own ceremonies that are less significant and easier at home. The scripture shown in this picture has been passed down for over 100 years but still looks impeccable because it has been kept and used very carefully only for important ceremonies. Scriptures can be categorized by types of ceremony and are of different sizes. For example, the scripture for an ordination ceremony is thick because it contains hymns that need to be sang through three days and nights. In contrast, scripture for teenagers to ask for forgiveness from their parents is only in a small book.

Box 1. Ghost doctor village.

Source: Tales of Treatment exhibition booklet.

The second example from the Tales of Treatment exhibition involved a traditional treatment adapted from "*gua sa*" (กัวซา) which was common in Thailand, China, and Southeast Asia more generally. Also known as *gua sha* in Chinese (刮痧), or "scraping" or "coining" in English (Nielsen *et al.*, 2007), *gua*

443 *sa* involved scraping the skin to stimulate blood circulation until bruises appear. The tale relayed by
444 Aunt Porn in Box 2 told of local adaptations of this practice that involved pulling rather than scraping
445 the skin – locally known as "*dueng sa*" (ดึงซา). Like the spiritual chants in the previous narrative, *dueng*
446 *sa* was a common skill in Aunt Porn's village, and its effectiveness was explained by the pain it
447 inflicted on the recipient. The insights generated by this tale did not only involve the local adaptation
448 of medical practices and the (for us) unexpected interpretations of how people assessed the quality of
449 *dueng sa* – very much unlike conventional Western interpretations of what "quality of care" would
450 entail. One of the main surprises from this story was also the idiosyncrasy of medical practices. Aunt
451 Porn's village performed an adaptation of *gua sa* that was different from local medical practice in
452 neighbouring villages. This begged the question, "What does 'traditional healing' mean at all, and how
453 can we usefully bring it into one category?"
454

Comfort From Pain – Pulling

Many people may have come across "Gua Sa," a renowned traditional Chinese therapy based on the same principle as acupuncture, which induces changes in the body by improving blood circulation. The practice involves scraping parts of body such as neck, back, and shoulders. Most of the time, this leaves conspicuous bruises and discoloured marks – triggering all kinds of imagination, curiosity, and alarm among those who do not know what could possibly have caused them.

In one of the villages that we surveyed, villagers developed a new technique of Gua Sa and gave it a new half-Thai-half-Chinese name, "Dueng Sa." Instead of scraping, the person who performs Dueng ("to pull") Sa would dip their middle and index fingers in water and use them to pull the skin on the chest, back, and shoulders in a specific order, creating therapy lines along the body (for example from the collar bone to the fingertips). It is something that villagers do on a regular basis, especially after a long day of work or when they feel unwell and fatigued. Some people would get the pulling treatment every day for relaxation, and if there is no one in their household to provide it, they can also easily walk over to any neighbour to ask for help – it is a common skill! Aunt Porn told us that when you start pulling, you should pull every spot on the line from where you started, otherwise, the body will lose balance and this could create dangerous consequences or even death. The people in this village prefer Dueng Sa to other Gua Sa methods because it involves an uncomplicated process and does not require any equipment. Moreover, they think it allows more force to be applied, which can create more pain and therefore yields better effects.

Box 2. Comfort from pain.

Source: Tales of Treatment exhibition booklet.

The final narrative, presented in Box 3, expanded beyond the conceptualisation of healing and treatment and related to the understanding of antimicrobial resistance as a global health issue. Grandma Kaew was among the last traditional healers in her village, applying knowledge passed down to her from generations ago. Fellow villagers received her herbal treatment for symptoms like headaches and indigestion, and steady demand had required her to process these herbs more efficiently. As she explored methods to store herbs for convenience and longer shelf life, she begun sun-drying herbs, blending them into fine powder, and apportioning them into small zip-lock bags. She also filled bitter-tasting herbs like "fah talai jone" ("ฟ้าทะลายโจร" or *andrographis paniculate*) into capsules so that children or patients who did not like taking medicines could use them as well.

468

At-home Medical Unit

In Grandma Kaew's view, it is not always a necessity to visit the hospital when she does not feel well. There are many ways she can look after herself and treat her illnesses, including using herbs and blowing sacred chants onto her body – the methods that were passed down to her from many generations ago. Grandma Kaew does not only cure her own illnesses, she is a "doctor" for the people around her, too. She told us that her relatives would often consult her and take her herbal medicines for symptoms like headache, breathing difficulties (e.g. after eating), or inability to burp. With the demands from her patients increasing, she looked for ways to process and store her herbs for longer shelf life and for her own convenience. She sundries the herbs she gathers from the forest and blends them in an electrical blender until they become fine powder which she then scoops into small zip-lock bags so that she can pull just the right amount out next time she needs them. Her creativity does not stop there, she also fills some bitter herbs into capsules so that children or those who do not like taking medicines can use them as well. Having these processes figured out, Grandma Kaew does not have to venture to the forest every time she needs ingredients – they are already sitting in her cupboard! Sadly, there are not many like her left in the village as no one wants to study her knowledge of herbal medicine seriously, and we may see it disappear not too long from now.

469

470 *Box 3. At-home medical unit.*

471 Source: Tales of Treatment exhibition booklet.

472

473 The significance of Grandma Keaw's story rested in the fact that modern Thai health policy had begun
474 advocating, among others, the treatment of uncomplicated conditions like sore throats with traditional
475 Thai herbal medicine. The purpose of this development had been to respond to healthcare providers
476 "who feel pressured by patients' expectations" for antibiotics and therefore reduce the reliance on
477 antibiotic treatment in human medicine (Sumpradit *et al.*, 2012:910). This tale underlined the irony of
478 this proposal: Herbal and non-medicinal alternatives for antibiotic treatment had been practised for
479 centuries, but were over the past decades increasingly crowded out by the modernization of medicine
480 (Muksong & Chuengsatiansup, forthcoming; Sringernyuang, 2000). One could therefore argue that

modern medicine had sown the seeds of its own demise through the "pharmaceuticalisation" of care (i.e. reducing treatment to the transaction of capsules), and now depends for its survival on the traditional medicine that it had been displacing. At the same time, critical academic voices wonder whether the modern Thai health policy approach incorporating herbal medicine capsules does, yet again, reduce holistic traditional treatment to a transactional relationship. Although this might be a valid concern, the fact that Grandma Kaew herself had been administering herbal medicines in capsules – for pragmatic reasons – indicated that she was very unlikely to be an agent of a neo-colonial agenda.

The practice of recording narratives alongside our survey enabled our research team to perceive illness and treatment beyond the questionnaire. Examples of local medical practice challenged our conceptualisation of care in rural northern Thailand – for example the dichotomy between population and healthcare providers, the spectrum of conditions that deserved a traditional healer's attention, and the fluidity of its performance – but it also added nuance to our understanding of modern health policy and its critiques in the context of AMR.

Reactions and reflections from the photo stories

"Tales of Treatment" was not only a mechanism to capture narratives from northern Thai villages, but also to acquaint the urban public interested in photography, culture, and alternative systems of medicine with this material. The overall more than 500 visitors across our four venues engaged enthusiastically with the exhibits, the stories, and the exhibition hosts, typically spending 45-60 minutes at the exhibition. Interactions between the research team and the participants revealed how the exhibition stimulated reflection and recall of personal treatment histories. For example, some of our Thai audience, including those from northern Thailand, said they had seen their parents or grandparents follow the practices shown in the photographic stories, but they had never experienced herbal or spiritual healing themselves, nor had they learned how these practices function. UK and US audiences related the content to the role of alternative medicine in their respective home countries, and drew

parallels between Thailand and Western countries in terms of sensemaking about the body, illness, and healing techniques. One US visitor in Bangkok also compared one of the stories – a ceremony post – to her experiences of traditional healing in Peru. In both cases, healers would examine animal parts to diagnose a patient's illness. In Chiang Rai, the tale was told that a ghost doctor would examine the bone marrow of fresh chicken thighs or a pig's liver before moving with the patient to the ceremony post to worship the ghosts for healing. In Peru, our visitor recalled, a ceremony master would use a Guinea pig to look for damaged organs to identify the associated human body part where disease was located. Not only our visitor but also the research team were intrigued by such parallels.

Written testimonies from exhibition guests suggested as well that the engagement with photography and stories about traditional healing sparked reflection. Participants related the content to their personal experiences growing up in families where modern medicine was unpopular ("*My dad never liked modern medicines so I've experienced* [traditional and alternative forms of healing] *a lot! Acupuncture, power therapy, psychotherapy,* […]") or in other Southeast Asian contexts where they encountered traditional forms of healing ("[…] *In Vietnam, we have a practice called cao gió – very popular for 'scratch*[ing] *out the wind' from a cold/fever* […];" "[…] *Particularly the Jham leaves* [story] *is reminiscent of something my grandma used to do for my mum!!!*"). Together with participants with an interest in research, we reflected yet further on intercontinental comparisons of behaviour and possible research avenues about the co-evolution and global spread of drug resistance and local forms of healing.

During the latest iteration of the exhibition at the Warwick Arts Centre, we collected more formal feedback in addition to verbal and guestbook testimonies. With a response rate of 33% (23 out of 70 visitors, all of whom were university students or staff), 95.7% agreed that they learned "something new" during the exhibition (100% of the responses agreed that the event was "worthwhile"). Among the explanations of what had been learned, the participants indicated, for example,

- "*'Alternative' treatments in other parts of the world*,"
- "*The popularity of using the supernatural*,"
- "*The interconnectedness of Thai, Chinese medicine*," and
- "*So much! In particular the pulling and pinching* [gua sa, dueng sa]."

The respondents of the evaluation form thereby appeared to appreciate the combination of photography, written stories, and first-hand accounts of the fieldwork to relay the tales of treatment ("*Enchanting photography*;" "*I love the pairing of story & photo*;" "*The walking tour allowed us to hear the story directly from someone who had conducted the research*").

Yet, not everyone was equally impressed. A subset of participants in all exhibition sites also expressed doubts both about the content of the stories (e.g. narratives about medicinal plants functioning as fever absorber) and the photographs themselves (e.g. concerns about animal cruelty where ghost doctors used tiger claws during treatment). Specifically with regard to antibiotics and drug resistance, some participants in Bangkok also enquired about the subject, behaving towards the team as if they were medical specialists. Although such feedback and reflections only arose in conversation with the participants rather than in writing, some participants also indicated that they had "*never realised how effective these treatments can be*." The exhibition stated explicitly that its intention was not to advocate a particular treatment method nor to suggest the superiority of traditional healing – rather, to relay stories from the field. Nevertheless, we as hosts may have on occasion been misinterpreted as medical specialists, and interpretations such as those indicated above may have potentially entailed unintended behavioural outcomes of the public engagement event.

Discussion

Summary

The case study has demonstrated the complementarities and essential contributions of knowledge co-production to the understanding of local health practices and global health priorities. These activities emerged partly in response to limitations of the survey design (e.g. that the survey team reported in feedback sessions on the limitations of the questionnaire), and enabled a better understanding of local conceptualisations of medicine, new insights into the social configuration of treatment seeking, for us otherwise invisible idiosyncrasies of traditional healing across villages in northern Thailand, new perspectives on the relationship between "the general population" and "traditional healers," and reflection on the relationship between modernity and tradition in AMR. At the same time, not all points raised in the co-production workshops could be supported by our quantitative survey data, and participation in the workshops and exhibitions appeared to have created misleading impressions of our purpose and messages among a small group of attendees. Despite its seeming value for challenging thought and research in global health, we should therefore not underestimate the consequences of intervening in a social system through co-production and bi-directional communication – however well-meaning it might be.

Our findings contribute to the practice of global health research and the empirical understanding of AMR as a global health priority. As opposed to mainstream community engagement activities in global health and AMR in particular (e.g. Redfern *et al.*, 2018), the case study demonstrated how researchers can learn from their target populations rather than instrumentalise "engagement" to change communities along biomedical ideals. The importance of bi-directional communication highlighted in our work indicated instead that global health researchers *require* local inputs to formulate hypotheses and ground analytical categories, and also to define the research problem itself – similar to arguments surrounding the practice of patient and public involvement in Western medical research (Boivin *et al.*,

2018; Staniszewska *et al.*, 2017). At the same time, the documented risks of the unintended consequences of engagement also expand the recent argument by Abimbola (2019:1, in the context of community health committees) to steer global health researchers and practitioners away from an unrealistically optimistic "*a priori* bias" in community engagement.

The insights provided by our public engagement participants further added to debates and empirical knowledge in the field of AMR. For example, the varied relationship between antibiotic conceptions and attitudes towards over-the-counter purchases related to the literature on language and local conceptions of antimicrobials (Charoenboon *et al.*, 2019; Mendelson *et al.*, 2017). Other locally grounded research hypotheses demonstrated how antibiotic usage differed across generations, which contributed to the understanding of the determinants of antibiotic use and the values that underlie antibiotic choices in Thailand and other LMICs (Haak & Radyowijati, 2010; Harbarth & Monnet, 2008; Sirijoti *et al.*, 2014:304). In addition, traditional healers are often portrayed as an unqualified source of antimicrobials or as a healthcare solution that could delay access to biomedically trained healthcare providers (Finnie *et al.*, 2011; Haak & Radyowijati, 2010). Rather than pitching traditional against formal healthcare, our participants rather demonstrated the fluidity of traditional healing and enabled reflections on the historical and current role of traditional medicine to save modernity and modern medicine from the threat of AMR (Chandler, 2019). Overall, the inputs from the participants in our project challenged assumptions and expectations among the international research team, helping to expand understanding incrementally and to challenge geographically and disciplinarily defined hierarchies of knowledge in global health research.

Limitations

The primary limitation of this research was that the co-production activities did not involve an independent evaluation. To an extent, it was essential for us as the research team to learn from the villagers to challenge our assumptions and broaden our perspective on global health. However, being

599 embedded in the research and positioning ourselves as "learners" vis-à-vis villagers and the public also
600 prevented the research team from carrying out a formal independent assessment of the consequences
601 of the activities. A parallel research team not involved in the project or its design would have ideally
602 worked alongside our group to add additional depth on the unintended consequences and potential
603 (and actual) benefits and harms arising from the co-production activities (resource constraints
604 prevented this in our project prevented). Despite our best attempts to be mindful of alternative
605 interpretations of our work and the negative outcomes of the activities, there remained thus a residual
606 risk that our position as social researchers invested in this project unconsciously biased us towards a
607 particular interpretation of the data and participants' responses.

608 The mixed insights from the quantitative analysis further indicated the shortcomings of using a pre-
609 specified survey instrument to assess locally emerging research hypotheses. Especially where the
610 quantitative findings did not support the hypotheses, the question remained whether this was because
611 the hypothesis could not be supported, or because the questionnaire and research design were not
612 suitable to investigate the respective point. Ideally, the development of the data collection instrument
613 should therefore have involved further iterations to accommodate these inputs (which is something we
614 are considering for future research).

615 ***Costs and risks of knowledge co-production***

616 Overall, our analysis suggested that there were clear complementarities between the co-production of
617 knowledge on the one hand, and the data collection methods and the interpretation of health behaviour
618 research on the other hand. However, these activities also produced costs and risky outcomes that we
619 discuss briefly in this section.

620 The workshop insights demonstrated how contributions from the target population could help to
621 improve survey data collection but also to formulate and test locally grounded research hypotheses.
622 There are alternative methods to learn about local knowledge and practices. Short of immersive

ethnographic research, cross-sectional qualitative research could have similarly helped to improve the understanding of local behaviours and medicine use, and to inform the development of a structured questionnaire. Qualitative pre-testing of the survey instruments – for instance through cognitive interviewing (Willson & Miller, 2014) – could have helped uncover unforeseen categories and refine quantitative data collection as well, although this often happens at a stage when research design and hypotheses are already relatively fixed. We applied both these techniques in this study, but the workshop setup helped to complement these qualitative approaches through a different set of techniques. Although activities like medicine pile sorting are not specific to a workshop setting and could in principle be also incorporated into semi-structured interviews and focus group discussions ("participatory" methods like pile sorting exercises have long been incorporated in development survey research; see Mayoux & Chambers, 2005), the wide range of media and activities during the workshop helped generate a more open and engaging atmosphere and enabled a greater degree of bi-directional knowledge exchange than could be achieved in the more structured data collection settings of face-to-face interviews or focus group discussions.

Aside from the monetary costs of the workshops (£450 per workshop for consumables and eight facilitating staff plus approximately £3,000 for consumables and staff costs for the development and trialling of the workshop format), the bi-directional communication activities themselves could also have risky behavioural consequences. For example, in previous publications, we demonstrated how information sharing from the research team to the participants increased superficial measures of "awareness" but potentially provoked adverse reactions like rumours or even a villager starting to sell antibiotics informally in her grocery store (Charoenboon *et al.*, 2019; Haenssgen *et al.*, 2018c).

Similarly, gathering and exhibiting photographic narratives from our field sites was an opportunity for the project to cultivate and benefit from the talent of the research team, and to learn about healing and treatment from the perspective of our participants – on their terms rather than ours. The narratives enabled us to explore perspectives that especially the non-Thai project collaborators would not have

considered otherwise. The visual component of the narratives thereby offered additional space for reflection compared to, for instance, a solely text-based semi-structured interview, and it opened a pathway to engaging the broader public interested in photography, culture, and traditional healing in our project. The latest exhibition at the Warwick Arts Centre also paved the way for closer collaboration between the research team and the creative industry.

However, knowledge co-production through visual methods and storytelling served primarily a supplementary purpose in our project – for our research objectives, it would have not have sufficed as an alone-standing research and knowledge production method (which comes with its own methodological and ethical challenges; Becker, 1995; Prosser & Schwartz, 2005). As the feedback from the photo exhibitions showed, presenting health-related practices could also potentially influence people's health behaviour even if the research team explicitly distanced themselves from advocating any particular practice. Lastly, the collection and preparation of the material and hosting the four photo exhibitions required a budget of approximately £8,000.

These costs and risks mean that knowledge co-production for instance through workshops and photographic narratives has to be weighed against alternative qualitative and quantitative modes of generating global health knowledge. As a complement to conventional research methods, however, they can usefully inform a project during its design phase, aid the interpretation of its results, and make the dissemination of its findings more effective. The costs and risks of these methods should therefore be seen in their value of *complementing and enhancing* conventional global health research.

Conclusion

Drawing on the discourse of AMR as a global health priority, this paper asked, "*Can knowledge co-production in global health research challenge hierarchies and promote engagement?*" We studied the case of a health behaviour research project in Chiang Rai province, northern Thailand, that involved the co-production of knowledge through participatory workshops and the collection and exhibition of

672 photographic "Tales of Treatment." Quantitative testing of locally grounded hypotheses, photographic
673 narratives, and event feedback challenged not only our own assumptions as health behaviour
674 researchers, but also offered new perspectives on global health debates in the field of AMR. The short
675 answer to the research question therefore is "Yes," knowledge co-production can challenge external
676 assumptions of illness and treatment, undermine entrenched hierarchies of knowledge, and promote
677 the public's engagement with research. But a tension remains between the benefits of co-producing
678 knowledge and the risk of inadvertently creating unintended consequences through public engagement
679 activities and the presence of external research teams.

680 The risks associated with public engagement highlight the need for extensive evaluation. The
681 knowledge to evaluate public engagement and participatory research is yet limited and requires further
682 methodological research (Charoenboon *et al.*, 2019; Etherton & Prentki, 2006; Galloway, 2009;
683 Lafrenière & Cox, 2013; Ledgard, 2013, 2016). Once evaluation frameworks and guidelines have been
684 established, varied applications of process, ex post, and impact evaluation (both qualitative and
685 quantitative) would enable us to map the consequences of knowledge co-production and to assess their
686 costs and benefits more comprehensively and pragmatically – even if the costs of an evaluation itself
687 mean that such assessments can only be conducted on a sample of research projects.

688 Overall, our analysis leads us to conclude that knowledge co-production should become a standard
689 secondary objective of global health research to prevent misrepresentation of local realities and to
690 more effectively ground the interpretations of its findings in the local context. One pre-condition of
691 this strategy to succeed is to frame global health research more actively as a learning exercise and
692 embed the agenda to "decolonise" global health more firmly in research education and international
693 health policy circles. An international commission – led by interdisciplinary researchers from low- and
694 middle-income countries – could further legitimise this practice by establishing formal ethical
695 guidelines for global health research to be more receptive to local voices, rather than merely
696 instrumentalising the rhetoric of public engagement for public health interventions.

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Appendix

Table A1. Comparison of antibiotic sources and use during acute illnesses and accidents across five age groups.

	Chiang Rai Village (1st survey round)						All Three Workshop Villages						Rural Chiang Rai Province					
	18-24	25-34	35-44	45-59	60+	*p*-Value	18-24	25-34	35-44	45-59	60+	*p*-Value	18-24	25-34	35-44	45-59	60+	*p*-Value
All illness episodes																		
Number	9	17	33	28	28		65	119	143	215	155		49	104	159	301	239	
% received antibiotics	11.1%	23.5%	15.2%	17.9%	7.1%	0.798	15.4%	20.2%	13.3%	13.0%	12.3%	0.086	12.3%	16.4%	30.4%	20.4%	14.2%	0.106
All antibiotic use episodes																		
Number	1	4	5	5	2		10	24	19	28	19		5	18	42	58	33	
% of antibiotic use episodes received from formal sources	100.0%	50.0%	100.0%	60.0%	100.0%	0.291	60.0%	70.8%	84.2%	75.0%	78.9%	0.511	100.0%	56.9%	90.5%	96.6%	84.5%	0.007
% of antibiotic use episodes received from informal sources	0.0%	50.0%	0.0%	40.0%	0.0%	0.291	20.0%	37.5%	15.8%	28.6%	21.1%	0.532	0.0%	54.9%	10.9%	4.5%	15.5%	<0.001
% of illness episodes with at least one instance of unfinished antibiotics	100.0%	75.0%	0.0%	60.0%	50.0%	0.102	70.0%	41.7%	21.1%	32.1%	52.6%	0.020	16.2%	35.0%	35.5%	52.9%	26.4%	0.389
% of episodes with at least one instance of strict adherence to antibiotic instructions	100.0%	75.0%	80.0%	20.0%	100.0%	0.240	50.0%	70.8%	78.9%	60.7%	68.4%	0.107	79.4%	32.9%	85.6%	72.6%	81.8%	0.002

Source: Authors, derived from survey data.

Notes. Data on illness episode level. Multiple illness episodes per respondent possible. Provincial-level results are population-weighted using census data. *p*-values calculated using Pearson X^2 test.

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Disclosure statement

We declare that no conflict of interest – financial or otherwise – exists.

Data availability

The survey data reported in this article is available via the UK Data Service (free safeguarded access):

Haenssgen MJ, Ariana P, Wertheim HFL, et al. (2019) Antibiotics and activity spaces: an exploratory study of behaviour, marginalisation, and knowledge diffusion [data set]. Colchester: UK Data Service.

1. Village Checklist (GPS coordinates of village and facilities) (to be completed by supervisor)

What kind of facility would you like to record?

A. District Number		[*code entered automatically*]
B. Village Number		[*code entered automatically*]
C. Village centre	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
D. Village head's house	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
E. Local shop	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
F. Market	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
G. Temple	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
H. School	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
I. Bus stop	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
J. Health facility Specify (public, private, pharmacy, local store, traditional healer, etc.): _____	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
	c) Who is staffing the facility?	Total staff: ___ Staff at time of visit: _____
	d) Does the provider have antibiotics available?	Yes .....1 No 0

Interview data [*Record observation*]		
i. District Number		[*code entered automatically*]
ii. PSU Number		[*code entered automatically*]
iii. Household number		Number: _____
iv. Household coordinates	a) Latitude	[*coordinates entered automatically*]
	b) Longitude	[*coordinates entered automatically*]
v. What type is this house most similar to?		1...  2...  3... 
vi. Time of visit	a) First visit	[*time entered automatically*]
	b) Second visit	[*time entered automatically*]

List all persons aged 18+ years in household

Hello, I'm a researcher working for the Mahidol-Oxford Tropical Medicine Research Unit. We are interested in the lives and health behaviours of villagers across Thailand and Lao PDR. We are selecting participants randomly and would like to choose one or two members of your household. In order to choose and ask them to participate, could you please tell us who lives here? [provide PIS on request]

[*1 respondent per every 5 household members will be selected randomly from this list*]

Name	Nickname	Sex (M / F)	Age	Available for interview today? (Yes / No)

Statement of consent (Respondent will receive participant information sheet and verbal consent will be taken)
Thank you for participating. You will receive a small token of gratitude for your participation at the end of the interview.

vii.Date of interview	[*date entered automatically*]
viii.Time of interview begin	[*time entered automatically*]
ix.Respondent name	Respondent name: _____
x.Interviewer code	[*code entered automatically*]

Part I: Personal and Household Characteristics
Let us begin with a few questions about yourself and your household.

1. [*record as observed*] Sex		Female..... 1 Male 0
2. How old are you? [*in years*] [*If respondent cannot give exact age, ask for approximate age and code in range: 18-24, 25-34, 35-44, 45-59, 60 and older*]		Age in years: _____
3. Please indicate what kind of work you do. If you have more than one occupation at one time or throughout the year, please begin with the one in which you spend the most time and name up to three. If you do not have an occupation, please also mention whether you are still a student, retired, or unemployed.	a) Main occupation	Occupation: _____
	b) Side occupation	Occupation: _____
	c) Side occupation	Occupation: _____
4. What is your mother tongue?		Mother tongue: _____
5. [In Thailand:] Can you speak Thai? [In Laos:] Can you speak Lao?		Yes ..... 1 No 0
6. What is the highest grade of schooling that you completed? [*excluding informal education and pre-school education such as nursery and kindergarten, but including grade school, high school, vocational training, tertiary education, etc.*]		Highest grade: ___
7. Are you the head of your household?		Yes .....1 No 0
7.1. [*if no*] What is the name of your household head?		Name: _____

8. What is your current marital status?	Never married ..... 1 Currently married ..... 2 Cohabiting ..... 3 Separated / divorced ..... 4 Widowed 5	
9. Are there any close family members of yours [children, spouse, siblings, parents] who live elsewhere? [***select "no" if not applicable***]	**9.1.** Do your parents live outside of this village? [***do not count parents-in-law***]	At least 1 person outside village .... 1 All inside village / not applicable.... 0
	9.2. Does your spouse live outside of this village?	At least 1 person outside village .... 1 All inside village / not applicable.... 0
	9.3. Do you have siblings who live outside of this village? [***do not count brothers-in-law and sisters-in-law***]	At least 1 person outside village .... 1 All inside village / not applicable.... 0
	9.4. Do you have children who live outside of this village?	At least 1 person outside village .... 1 All inside village / not applicable.... 0

Part II: Social Networks [for network census villages only]
I will now ask you some questions about your interactions with other people within and outside of your village.

10. **[Round I of network survey only]** Where do you spend most of your time interacting with other people from your village?	a) Field: ___ b) Temple: ___ c) Local store: ___ d) Market: ___ e) Children's schools: ___ f) Home: ____ g) Workplace: ___ h) Village event/s: _____ i) Other site: ___

11. [Round I of network survey only] Outside your household, with whom do you interact on a regular basis? (May be anyone from both inside and outside of the village, and through any platform which might not require a face-to-face interaction)

	a) What is the nickname of the person?	b) How is this person related to you? [*give examples if respondent is unsure about answer categories*]	c) What is the sex of this person?	d) Where does this person live?	e) What is the name of the household head of this person?	f) How often do you interact with this person?	g) How do you interact with this person? [*Mark all that apply*]	h) Do your conversations relate to health and well-being?
11.1. Contact 1	Nickname _____ Name _____	Spouse..... 1 Parent..... 2 Child ..... 3 Sibling..... 4 Other relative ..... 5 Neighbour..... 6 Friend (if not neighbour)..... 7 Other villager..... 8 Other (specify) _..... 9	Female...1 Male 0	In village ..... 1 (specify: _____) Outside village .. 2	Name of household head _____	Daily or more often .....4 Weekly or few times/week .....3 Monthly or few times/month ...2 Yearly or few times/year .....1 Less often or never.....0	Face-to-face... 1 Voice call..... 2 Messenger ..... 3 Other (specify) _____ 4	Yes ..... 1 No 0
11.2. Contact n	Nickname Name	1 2 3 4 5 6 7 8 9	1 0	1 2	Name	0 1 2 3 4	1 2 3 4	1 0

11a. [Round II of network survey only] When we last visited you, you told us that you interact regularly with [*names*]. Has anything changed since last time?	Yes .....1 → **[update social network question 11]** No 0
11i. [Round I of network survey only] Is there anybody in your household with whom you talk about health and well-being? [***Mark all that apply***]	[***mark all names from household roster that apply***]

[*For network survey village respondents in Round 2*]

12. An education activity has recently taken place in your village.

12.1. Did you participate in any of the activities?	Yes ..... 1 Yes, but not throughout ..... 2 No ..... 3 Don't know / prefer not to say 4
12.2. Did you talk with anybody about the activity in your village? [*"Talking" can involve any conversation including asking for information, informing about the educational activity, or discussing it (regardless of actual attendance)*]	a) Nickname 1: _____ b) Full name 1: _____ c) Relationship 1: 1 2 3 4 5 6 7 a) Nickname n: _____ b) Full name n: _____ c) Relationship n: 1 2 3 4 5 6 7 [*Relationship codes*] Household member ..... 1 Family member outside HH ..... 2 Other relative ..... 3 Neighbour ..... 4 Friend other than neighbour ..... 5 Other villager ..... 6 Other (specify) _ 7
[*If respondent indicates conversation in Q 12.2*] **12.3.** What subjects did you talk about in respect to the activity? [*mark all that apply*]	Going to doctor when sick ..... 1 Anti-inflammatories/antibiotics ..... 2 Germs ..... 3 Using medicines correctly ..... 4 Activity in general ..... 5 Games/awards ..... 6 Song/Story/Play ..... 7 Money/compensation ..... 8 Other (specify) ____ 9

Part III: Healthcare Seeking Thank you for this. Now we come to a part where I will ask you some questions about health and health providers around here.

13. I would now like to ask you about the sources of health advice and medicine or other treatment that are available to you. Please think about all the places where you can go to get advice, treatment, or drugs if you (or your children) are sick.

Do you consider the following providers when you (or your children) feel unwell?

[*Mark all that apply*]

13.1. Drug dispensary, other local store selling medicine	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99
13.2. Traditional healer	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99
13.3. Pharmacist	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99
13.4. Private clinic	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99
13.5. Private hospital	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99
13.6. Health volunteer	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99
13.7. Public primary care unit	Consultation ..... 1 Medical advice ..... 2 Access to medicine ..... 3 Other reason(s) ..... 4 Don't consider this provider ..... 98 Don't know such a provider 99

	13.8. Public hospital	Consultation ..... 1 Medical advice..... 2 Access to medicine..... 3 Other reason(s) ..... 4 Don't consider this provider..... 98 Don't know such a provider 99
	13.9. Other providers or Internet? Specify: _____	Consultation ..... 1 Medical advice..... 2 Access to medicine..... 3 Other reason(s) ..... 4 Don't consider this provider..... 98 Don't know such a provider 99

14. Now if you think again, is there anyone else with whom you talk about health?

	a) What is the nickname of the person?	b) What is the full name of the person?	c) How is this person related to you? [*give examples if respondent is unsure about answer categories*]	d) What is the sex of this person?	e) Where does this person live?	f) What is the name of the household head of this person?	g) How often do you interact with this person?	h) How do you interact with this person? [*Mark all thatapply*]
14.1. Contact 1	Name _____	Name _____	Spouse..... 1 Parent ..... 2 Child ..... 3 Sibling..... 4 Other relative ..... 5 Neighbour..... 6 Friend (if not neighbour)..... 7 Other villager..... 8 Other (specify) _..... 9	Female ..1 Male 0	In village ..... 1 (specify: _____) Outside village .. 2	Name of household head _____	Daily or more often .....4 Weekly or few times/week .....3 Monthly or few times/month ...2 Yearly or few times/year .....1 Less often or never.....0	Face-to-face..... 1 Voice call..... 2 Messenger ..... 3 Other (specify) _____ 4
14.2. Contact n	Name	Name	1 2 3 4 5 6 7 8 9	1 0	1 2	Name	0 1 2 3 4	1 2 3 4

15. Did you or a child in your household have an acute illness (not a chronic, long-term condition that comes again and again) or an accident in the last two months? If yes, I will ask you about these illnesses one-by-one. [*if no, continue with Question 19*]	No.....0 ➔ [*Q 16*] Yes.....1 ⬇
[*if yes*:] **15.a** [Confirm if this episode is for respondent or child]	Respondent .....1 ➔ [*Q 15.1*] Child 2
15.b How old is the child?	Age in years: _____
15.c Is the child female or male	Female .....1 Male 0
15.1. Can you please describe the symptoms or problem in your own words?	Description of condition: _____
15.2. Did [you / the child] receive a diagnosis of the illness from any medical provide, friend, or internet source? If so, can you please describe the diagnosis of the illness if you received any and where [you / the child] received it? [***note: the diagnosis might be given by any medical provider including untrained and informal. Record all diagnoses if more than one.***]	a) Diagnosis 1: _____ b) Medical provider 1: 1 2 3 4 5 6 7 8 a) Diagnosis n: _____ b) Medical provider n: 1 2 3 4 5 6 7 8 [***Response codes***] Drug dispensary, other local store selling medicine .....1 Traditional healer.....2 Pharmacist .....3 Private clinic.....4 Private hospital .....5 Primary care unit .....6 Public hospital.....7 Other providers or Internet? Specify: _____.....8
15.3. When did [you / the child] experience the accident/discomfort (for the first time)	Onset: ___ days / _____ weeks / _____ months ago
15.4. Would you describe the illness/accident as "mild," "moderate," or "severe"?	Mild.....1 Moderate.....2 Severe 3

15.5. Can you please explain the stages of the treatment? I will ask you step-by-step what you did, starting from the moment [you / the child] first experienced a discomfort.

	15.5.1. Step 1 (detection)	Step n
a) What kind of help or treatment did you get at this stage? [*if unsure, specify*]	Ignored /did nothing .....1 Self-care (sleep, rest, medicine at home) .....2 Care from family and friends (full-time).....3 Treated/consulted at a traditional healer .....4 Treated/cons. at a pharmacist.....5 Treated/cons. at shop selling drugs.....6 Treated/cons. at priv. clinic/hospital.....7 Treated/cons. at primary care unit.....8 Treated/cons. at a gvt. Hospital.....9 Other (specify) _____.....10	1 2 3 4 5 6 7 8 9 10
b) Where did this activity take place?	At home .....1 Less than 10 min. from home.....2 10 to 29 min. .....3 30 to 59 min. .....4 60 to 119 min. .....5 2 hours or more from home.....6	1 2 3 4 5 6
c) How did [you / the child] get to the place of the activity? [***select "at home" according to prior responses***]	At home .....1 Walk .....2 Own bicycle .....3 Own motorcycle / Three-wheeler .....4 Own car / four-wheeler .....5 Taxi or other hired ride.....6 Public transport.....7 Other (specify) ___ 8	1 2 3 4 5 6 7 8
d) How long did this stage last? [***let respondent choose category; if <1 day, code "1" day***]	Duration: ___ days ___ weeks ___ months	___ days ___ weeks __ months
e) Can you please name or describe all the medicines that you received or were prescribed during this step? [***include medicine stored at home if "self-care at home"***] [***continue for all medicines received, then complete Questions g to k for each medicine individually***]	 Medicine 1: Name/description: _____ Medicine n: Name/description: _____	Medicine 1 Medicine n
f) For how long did [you / the child] take the medicine? [***let respondent choose category; if more than one repeated episode, indicate total duration***] [***for each medicine individually***]	Duration: ___ days ___ weeks ___ months	___ days ___ weeks __ months

g) How often per day did [you / the child] take the medicine? [*calculate into daily use according to respondent's chosen frequency*] [*for each medicine individually*]	Frequency: ___ times daily	___ times daily
h) What dosage did [you / the child] normally take? [*let respondent choose category according to type of medicine*] [*for each medicine individually*]	Dosage ___ tablets / capsules ___ drops (for liquid medicine) ___ spoons (for liquid medicine) ____ shots/injections (for intravenous medicine) per time administered	___ tablets ___ drops ___ spoons ___ shots

i) Did [you / the child] take the medicine exactly as it was recommended to you by the person who prescribed/sold them [*for each medicine individually*]	Yes ..... 1 No ..... 0 Did not receive advice ..... 9 Don't know 99	1 2 9 99
j) Did [you / the child] finish the medicine? [*for each medicine individually*]	Yes ..... 1 No 0	1 0
k) Did you or anybody else use a mobile phone during this stage <u>in connection with your condition</u>? [*if no, go to next step*]	Yes ..... 1 No ..... 0 ➔ [*next step*]	1 0
l) What was the purpose of using the mobile phone? [*Mark all that apply*]	Ask for advice ..... 1 Call for treatment ..... 2 Arrange transport ..... 3 Appointment ..... 4 Reassure family/friends ..... 5 Ask for money/supplies ..... 6 Provider contacting me for information ..... 7 Treatment reminder ..... 8 Other (specify) _ 9	1 2 3 4 5 6 7 8 9
m) Which mobile phone functions did you or anybody else use? [*Mark all that apply*]	Call ..... 1 SMS ..... 2 Internet, messenger ..... 3 Alarm, calendar, reminder, etc. ..... 4 Other (specify) _ 5	1 2 3 4 5

15.6. [Have you / has the child] now recovered from the illness/accident?	Yes ..... 1 No 0
15.7. Was anybody of your personal relationships involved in providing advice or help <u>during the illness</u>? [*record up to ten names*]	Yes ..... 1 No 0
[*For district survey*] **15.7.b** How are these people related to you? [*Mark all that apply*]	Spouse ..... 1 Parent ..... 2 Child ..... 3 Sibling ..... 4 Other relative ..... 5 Neighbour ..... 6 Friend (if not neighbour) ..... 7 Other villager ..... 8 Other (specify) _ 9
15.7.c What kind of support did they provide? [*Mark all that apply*]	Providing healthcare/attending ..... 11 Providing advice ..... 12 Providing medicine ..... 13 Lending/granting money ..... 21 Transportation/Lending vehicle ..... 22 Contacting family/friends ..... 23 Providing food ..... 31 Helping with children/housework ..... 32 Helping with jobs/agriculture work (feeding animals/tending crops/covering shifts, etc.) 33 Other (specify) _ 99

[*For network survey*]	a) What is the name of the person?	b) How is this person related to you?	c) What kind of support was provided? [*mark all that apply*]
15.7.1. Contact 1	Name: _____	Spouse ..... 1 Parent ..... 2 Child ..... 3 Sibling ..... 4 Other relative ..... 5 Neighbour ..... 6 Friend (if not neighbour) ..... 7 Other villager ..... 8 Other (specify) _ 9	Providing healthcare/attending ..... 11 Providing advice ..... 12 Providing medicine ..... 13 Lending/granting money ..... 21 Transportation/Lending vehicle ..... 22 Contacting family/friends ..... 23 Providing food ..... 31 Helping with children/housework ..... 32 Helping with jobs/agriculture work (feeding animals/tending crops/covering shifts, etc.) 33 Other (specify) _ 99
15.7.2. Contact n	Name	1 2 3 4 5 6 7 8 9	11 12 13 21 22 23 31 32 33 99

15.8. Did you have another acute illness (not a chronic, long-term condition that comes again and again) or an accident in the last two months? [*if yes, complete another sheet for Question 15*]	Yes ..... 1 ➔ [*Q 15*] No ..... 0 ⬇

16. I would now like to ask you your opinion about medicine. There are no right or wrong answers, I only want to understand what you think. Consider the following medicines:

16.1. Have you seen these medicines before?	Yes ..... 1 No ..... 0 ➔ [*Q 16.4*]

16.2. What do you call this medicine?	Antibiotics ท่านเรียกยานี้ว่าอะไร ..... 11 Anti-inflammatory ยาแก้อักเสบ ..... 12 Germ killer ยาฆ่าเชื้อ ..... 13 Amoxy / Amoxicillin อะม็อกซี่/อะม็อกซี่ซิลลิน ..... 14 Sore throat medicine ยาแก้เจ็บคอ ..... 15 Cough medicine ยาแก้ไอ ..... 16 Pain reliever ยาแก้ปวด ..... 17 Fever reliever ยาแก้ไข้ ..... 18 Other (specify: ____) อื่นๆ (โปรดระบุ) ..... 98 Germ preventer / antibiotic ຢາຕ້ານເຊື້ອ ..... 21 Amok ຢາຕ້ານເຊື້ອ ..... 22 Ampi ຢາແອມປິ ..... 23 Tetra ຢາເຕຕ້າ ..... 24 Gulolam ກູໂລລາມ ..... 25 Sepasin ເຊພາຊິນ ..... 26 Other (specify: __) 99
16.3. What symptoms or illnesses would you use this medicine for?	Fever ..... 1 Cough ..... 2 Sore throat ..... 3 Inflammation ..... 4 Cold, flu, runny nose ..... 5 Diarrhoea ..... 6 Headache ..... 7 Stomach ache ..... 8 Muscle pain, other aches ..... 9 Skin diseases, rashes, lumps ..... 10 Wounds ..... 11 Urinary tract infections ..... 12 Every kind of sickness ..... 13 Whatever the doctor suggests ..... 14 Don't know / prefer not to say ..... 98 Other (specify: __) 99
16.4. Is there any situation for which you would buy this medicine?	Desirable attitude/knowledge ..... 1 Undesirable attitude/knowledge ..... 0 No attitude / refuse to answer (respondent is aware, but doesn't reveal attitude) ..... 97 Answer does not apply to question (respondent may be aware/unaware; satisficing) ..... 98 Not aware of this medicine (awkward, cannot answer but does not try to satisfy) 99
16.5. Do you prefer other remedies such as herbs or cough syrup to this medicine for [sore throat]?	Desirable attitude/knowledge ..... 1 Undesirable attitude/knowledge ..... 0 No attitude / refuse to answer (respondent is aware, but doesn't reveal attitude) ..... 97 Answer does not apply to question (respondent may be aware/unaware; satisficing) ..... 98 Not aware of this medicine (awkward, cannot answer but does not try to satisfy) 99
16.6. If you were prescribed this medicine by a doctor and did not finish the course, would you keep it for future use?	Desirable attitude/knowledge ..... 1 Undesirable attitude/knowledge ..... 0 No attitude / refuse to answer (respondent is aware, but doesn't reveal attitude) ..... 97 Answer does not apply to question (respondent may be aware/unaware; satisficing) ..... 98 Not aware of this medicine (awkward, cannot answer but does not try to satisfy) 99
16.7. Have you heard about drug resistance? (**16.7a** using alternative term "lueng yah" in Lao)	Yes ..... 1 No 2
16.8. What do you think is drug resistance? (**16.8a** using alternative term "lueng yah" in Lao)	Bacteria are resistant to medicine ..... 1 Antibiotics become less effective if used wrongly/too much ..... 2 Medicine in general becomes less effective if used wrongly/too much ..... 3 Being stubborn to take medicine ..... 4 Being addicted to medicine ..... 5 Drug allergy ..... 6 Lueng yah (drug resistance) ..... 7 Answer does not relate to drug resistance ..... 8 Other (specify) ..... 98 "Don't know" 99
16.9. Can your drug resistance ("*due yah*") spread to other people, for example if you sneeze on them?	Desirable attitude/knowledge ..... 1 Undesirable attitude/knowledge ..... 0 No attitude / refuse to answer (respondent is aware, but doesn't reveal attitude) ..... 97 Answer does not apply to question (respondent may be aware/unaware; satisficing) ..... 98 Not aware of this medicine (awkward, cannot answer but does not try to satisfy) 99

Part IV: Household assets

We now come to the last part. Can you please provide me with some information about your household?

17. How many rooms does this house have apart from toilet and hallways?	Number of rooms: _____
18. What is the electricity situation in your household on a typical day?	Power at all times, no power cuts (90-100%) ..... 1 Power most of the time, occasional power cuts (>50%) ..... 2 Power sometimes, frequent power cuts (<50%) ..... 3 No electricity 4
19. What kind of toilet does this house have and is it shared with other people in this community? ***[if more than one, choose "best" toilet] [use show card to facilitate answers]***	Unshared flush toilet (e.g. piped sewer system, septic tank, pour flush toilet) ..... 1 Shared (flush or non-flush) toilet with other community members or public toilet 2 No facility, Bush, Field, or others 3
20. What is the drinking water source of this house and is it shared with other people in this community? [***use show card to facilitate answers***]	Water piped into house or yard ..... 1 Water not directly piped into house or yard (e.g. well, borehole, water from spring, rainwater, tanker truck, surface water including rivers, bottled water, etc.)2
21. What kind of fuel does this household use for cooking?	Improved fuel source (e.g. Electricity, gas stove, etc.) ..... 1 Unimproved fuel source (e.g. Coal / Lignite, Charcoal, Wood, Straw / Shrubs / Grass, Animal dung, Agricultural crop residue) ..... 2 No food cooked in household 3

22. I will now ask you for some items in your household. Please tell me…	Number of items in household:	
	22.1. Have you got a *functioning* **radio** in your household? If so, how many?	__
	22.2. Have you got a *functioning* **TV** in your household? If so, how many?	__
	22.3. Have you got a *functioning* **rice cooker** in your household? If so, how many?	__
	22.4. Have you got a *functioning* **landline telephone** in your household? If so, how many?	__
	22.5. Have you got a *functioning* **mobile phone** in your household? If so, how many?	__
	22.6. Have you got a *functioning* **computer** in your household? If so, how many?	__
	22.7. Have you got a *functioning* **bicycle** in your household? If so, how many?	__
	22.8. Have you got a *functioning* **scooter, motorcycle, or tricycle** in your household? If so, how many?	__
	22.9. Have you got a *functioning* **car or truck** in your household? If so, how many?	__
	22.10. Have you got a *functioning* **tractor** in your household? If so, how many?	__
	22.11. Have you got a *functioning* **refrigerator or freezer** in your household? If so, how many?	__

23. How long does it normally take you to get to the following places?	**23.1.** How long does it take to get to the nearest market?	Less than 10 minutes ..... 1 10 to 29 minutes ..... 2 30 to 59 minutes ..... 3 60 to 119 minutes ..... 4 2 hours or more 5
	23.2. How long does it take to get to the village hall or the village head's house?	Less than 10 minutes ..... 1 10 to 29 minutes ..... 2 30 to 59 minutes ..... 3 60 to 119 minutes ..... 4 2 hours or more 5
	23.3. How long does it take to get to the nearest public or private doctor?	Less than 10 minutes ..... 1 10 to 29 minutes ..... 2 30 to 59 minutes ..... 3 60 to 119 minutes ..... 4 2 hours or more 5
24. What is your religion?		No religion ..... 0 Buddhist ..... 1 Christian ..... 2 Muslim ..... 3 Spirit (religious belief in Lao) ..... 4 Other (Specify) _____ ..... 5 Don't know 99
25. What is your nationality?		Thai ..... 1 Lao ..... 2 Myanmar/Burmese ..... 3 Chinese ..... 4 Other (Specify) _____ ..... 9 Don't know 99

26. What is your ethnic background?	Thai .....1 Tai Yai.....2 Akha (E-Koh).....3 Pakakeryor (Karen).....4 Lahu (Muser) .....5 Lisu (Lisaw) .....6 Hmong (Meaw) .....7 Mien (Yao) .....8 Burmese.....9 Yunnan (Jin Haw).....10 Tai Lue (Tai) .....11 Lao.....21 Kathuic.....22 Bahnaric Khmer.....23 Tai Thai.....24 Other (Specify) _____.....30 Don't know 99
xi. Interview end time	[***time entered automatically***]
Thank you very much for participating in this survey. [***give gift to respondent***]	
Part V: Interviewer observations [to be completed by interviewer after interview]	
xii. Was the interview completed?	Yes.....1 Yes, with difficulties .....2 No 3
xiii. Was someone else present during the interview? [***mark all that apply***]	Survey supervisor .....1 Other household or family member .....2 Medical practitioner.....3 Government officer.....4 Other (specify) ____.....5 No one 0
xiv. What is your evaluation of the accuracy and trustworthiness of the informant's answers?	Very good .....1 Satisfactory.....2 Doubtful.....3 Very low.....4
xv. Were there any unusual circumstances during the interview?	Please describe: _____