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Health service needs and perspectives of a rainforest conserving community in Papua New Guinea's Ramu lowlands: a combined clinical and rapid anthropological assessment with parallel treatment of urgent cases

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- 2 conserving community in Papua New Guinea's Ramu
- 3 lowlands: a combined clinical and rapid anthropological
- 4 assessment with parallel treatment of urgent cases
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- **Keywords:** Primary care; Tropical medicine anthropology, epidemiology; Qualitative research;
- 30 Health services administration and management; Neglected diseases.

ABSTRACT

- *Objectives.* Determine community needs and perspectives as part of planning health service
- 34 incorporation into Wanang Conservation Area.
- 35 Design. Clinical and rapid anthropological assessment (individual primary care assessments, Key
- 36 Informant [KI] interviews, Focus Groups [FGs], ethnography) with parallel treatment of urgent cases.
- **Setting.** Wanang (pop. c189), a village in the rainforests of Madang province, Papua New Guinea.
- *Participants.* 129 villagers provided medical histories (54 females (f), 75 males (m); median 19y,
- range 1mo-73y), 113 had clinical assessments (51f, 62m; median 18y, range 1mo-73y). $26 \ge 18y$
- participated in sex-age stratified FGs (f<40y; m<40y; f≥40y; m≥40y). Five KIs were interviewed (1f,
- 41 4m). Data collectors recorded daily ethnographic fieldnotes.
- *Results.* Of 113 examined, 11 were 'well', 62 (30f, 32m) treated urgently, 31 referred (15f, 16m),
- 43 indicating considerable unmet need. FGs top-4 ranked health issues concorded with KI views, medical
- histories, and clinical examinations. For example, ethnoclassifications of three ([a] "malaria",
- 45 [b] "sotwin", [c] "grile") translated to the five biomedical conditions diagnosed most ([a] malaria, 9
- villagers; [b] upper respiratory infection, 25; lower respiratory infection, 10; tuberculosis, 9; [c] tinea
- imbricata, 15), and were highly represented in declared medical histories ([a] 75 participants, [b] 23,
- 48 [c] 35). However, 29.2% of diagnoses (49 of 168) were limited to one or two people. Treatment
- 49 approaches included plant-medicines, stored pharmaceuticals and occasionally rituals. Protracted
- travel to hospital/pharmacy was sometimes undertaken for severe/refractory disease. Service barriers
- 51 included: no health patrols or easily reachable aid post; remote town hospital; unfamiliarity with
- 52 institutions; medicine costs. FG service introduction priorities were: aid post; child vaccinations;
- transport; perinatal/birth care; family planning.
- *Conclusions.* In a place with no prior health data, this study enabled service planning and
- demonstrated medical need sufficient to acquire funding to establish local primary care. In doing so, it
- has aided Wanang's community to develop sustainably, without sacrificing their forest home.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This research was a response to a community request rather than external disease priorities, thus better supporting community determined service planning.
- The methodology enabled rapid assessment of Wanang's health issues within cost-effective time frames.
- The mixed-method approach provided increased confidence in findings by triangulation of qualitative and quantitative data.
- Treating urgent cases was an immediate benefit to partner communities in advance of full provision of health services.
- Rapid assessments can overlook nuances which may be picked up by more prolonged ethnographic methodologies, and the breadth of health issues assessed reduced capacity to report specific health burdens as accurately as single-disease focused research.

INTRODUCTION

 Papua New Guinea's (PNG) health-related UN Sustainable Development Goal indicators are worse than all but two nations outside Africa,[1] and its rainforests are threatened by commercial logging driven primarily by global commodity demands.[2, 3] We report a health needs assessment carried out as our first step to simultaneously act on both these crises, by supporting a medically neglected community who are conserving their forest. In a community with no prior patient data, this study enabled service planning and demonstrated medical need sufficient to successfully acquire funding for establishment of primary care services sited in the community. Here we outline site-specific context, biodiversity and health issues in PNG and our methodological rationale are discussed in detail in our published protocol.[4]

Medicine and remoteness in PNG

If you were to find yourself in the provincial town of Madang on New Guinea's north coast and had access to a 4x4 vehicle that could traverse seasonal logging roads, you could start to make your way to the village of Wanang (figure 1 a). After 3–4 hours of driving into the forested interior, the increasingly deteriorating roads (figure 1 b) abruptly end. A waist-deep river crossing and a few hours of trekking later and you would arrive in a distributed settlement of c.189 people, surrounded by food gardens and 15,000ha of conserved rainforest (map, figure 1 c). For two decades scientists from PNG and as far away as the Czech Republic and the USA have made this journey to conduct ecological research with the people of Wanang. For the first author, and probably others, this journey is experienced as an exciting adventure into a remote interior. Yet, this is an outsider perspective, likely shaped in part by colonial-era established cultural tropes around 'expeditions'.[5, 6] In contrast, for Wanang villagers (such as co-authors JP and RU), the 80km journey in-reverse to Madang, is that needed to access the nearest hospital or pharmacy. Given the absence of primary care services in the community, from this perspective it is not their community that has been 'remote', but rather modern medicine.

Difficulties in accessing health services are common for c87% of PNG's c9 million population who live in rural communities.[7] PNG has one national referral hospital and 36 provincial and district hospitals, largely sited in towns. Reaching these facilities is expensive and difficult for most rural residents, even when healthy. Official rural primary care is provided at c3000 health centres and aid posts,[7] staffed by health-extension officers and nurses, and operated by government, churches, NGOs, or commercial interests such as mines.[8] These offer basic diagnoses, medical supply, and trauma treatment, and refer on to specialist services. However, even these can take days to walk to over rough terrain. This was the case at Wanang in 2016 when ecologists from New Guinea Binatang Research Centre (https://www.ngbinatang.com/) and community members (including leaders of all Wanang's nine clans) met to discuss the future of a long-standing conservation collaboration. This

had been formed in 2001 when the logging frontier reached Wanang, and clans refused corporate inducements and pressure, declaring most of their forest home as the Wanang Conservation Area.[3] To make their initiative viable in the long-term they reached out to ecological researchers to access development benefits. These have included research training and employment, a school, transportation, and income.[3] The meeting in 2016 identified healthcare as 'the main missing service' [9] to be developed in the collaboration's next phase. In more industrialised countries, clinical interactions are commonly recorded electronically in routinely collected patient data.[10] In contrast, in rural PNG aid post workers have traditionally

recorded total consultations and broadly what they were for on a single-sheet yearly form, but generally do not keep patient data. Instead, individuals have been encouraged to obtain pamphlet-style health books which they keep at home (figure 1 e and f), in which information is entered for reference the next time treatment is sought. In principle this has been sensible given available resources. However, health books are often scarce, and can deteriorate quickly in wet, humid rainforest environments. Additionally, some hospitals require individuals have health books to receive treatment (effectively making them care passports), so they are often surreptitiously shared and thus include records of multiple individuals as though they are one person, making them inaccurate sources of medical history.[11] During the design of this health needs assessment [12] community members reported that few people had health books. With no aid post, summary information on burdens was unavailable. This then was the clinical situation at Wanang; remote secondary care; no primary care services in the community; sparse, unreliable, and dispersed patient data.

Aims

- We aimed to plan health service incorporation into the conservation collaboration. Seeking to describe disease burden and determine service priorities, our research question was: What are Wanang's health
- needs?
- To understand community perspectives and the context for interventions, we also had two subsidiary
- questions: (1) How do people in Wanang classify diseases, their symptoms, and causes? (2) How are
- these treated, and by whom?

METHODS

Study design

We carried out a clinical and rapid anthropological assessment with parallel treatment of urgent cases, in Wanang between 17–25 July 2018. It consisted of Key Informant (KI) interviews, Focus Groups (FGs), individual clinical assessments by a general practitioner (with treatment and referral where necessary), and ethnography (methodological flowchart, figure 2). This enabled rapid collection of qualitative and quantitative data (at individual and community levels), and subsequent triangulation. It

also provided immediate clinical benefits. Our methods are detailed in our published protocol;[4] here we give an outline and describe changes. A reporting checklist following 'Appraising studies in health using rapid assessment procedures'[13] is in supplementary file (p.2). JM designed the protocol in discussion with its co-authors,[4] after consideration of participatory planning case studies archived at the Participation Resource Centre.[14]
Data was collected by a team from Brighton and Sussex Medical School in the UK (co-authors JM and GC) and Binatang Research Centre in PNG (co-authors MJ, JP, and SS) (backgrounds and capacity building, supplementary file, p.3). All residents of Wanang were eligible and invited for clinical assessments, those ≥18y for FGs. Recruitment for both was self-selecting, by attending the temporary research shelter after a village meeting. KIs ≥18y were purposively selected based on Research Technician (RT) knowledge. Informed consent is described in the ethics statement. Digitally recorded FGs were held separately by sex-age (females [f]<40y, males [m]<40y, f≥40y, m≥40y) in Tok Pisin (PNGs national creole). Similarly, interviews and clinical assessments, unless participants preferred English. Recordings were transcribed verbatim in Tok Pisin, then translated into English. Primary care assessments were conducted simultaneously with FGs, and involved taking medical history, clinical interview and examinations, using basic diagnostic equipment and malaria Rapid Diagnostic Tests (RDTs) when deemed necessary. Team members wrote daily ethnographic fieldnotes. Our protocol's supplementary file[15] includes: topic guides; consent and clinical data collection forms; treatment formulary and equipment; safety measures.
JM conducted analysis informed by multidisciplinary reflection from fellow co-investigators and collaborators: specifically, from anthropology (JF and HM), ecology (FD, VN, MP, AJS), global health (MGH), mycology (JI), PNG health research (ML, WP), primary care (GC), epidemiology (JAC), statistics (CIJ), philosophy of medicine (JAS), and dermatology (SLW). The eight co-authors who are PNG nationals (FD, MJ, ML, JP, JP, WP, SS, RU) contributed, in addition to disciplinary knowledge, essential contextual understanding. Quantitative data were entered into Microsoft Excel, and descriptive statistics generated on participation, medical histories, diagnoses, treatments, and referrals. Qualitative data from FG and KI transcripts (primarily in national language Tok Pisin with side-by-side English translations), alongside medical history from patient assessments, and research staff fieldnotes were imported into NVivo 1.6.1 (QSR International, Melbourne) and analysed to produce three outputs. Firstly, sex-age FG rankings of health issues affecting the community and service priorities (collected using nominal group technique[16]) were tabulated, compared, and contextualized with explanations from the wider data. Secondly, disease ethnoclassification taxonomies were created by coding data to pre-chosen higher order themes (e.g., perceived causes, symptoms, appropriate treatments) as per Scrimshaw & Hurtado.[17] Thirdly, a narrative description
of community perspectives on service provision was produced by coding to main themes in our topic

guides, with additional themes added as they emerged during repeated readings. In all cases,

 framework analysis[18] was conducted with matrixes generated in NVivo to enable ordering of themes and comparative analysis. To increase credibility: qualitative and quantitative data were triangulated; available KIs were given transcripts to check; co-author RTs with prior experience of the community, including two from Wanang, commented on interpretations; disease names/descriptions identified by FGs are given in Tok Pisin as well as English to demonstrate valid translation (table 1); supporting quotes are provided in the main text and in ethnoclassification taxonomies (tables S3–S6, supplementary file, p.6–9). To reduce bias, the diagnosing clinician (GC) was not involved in FGs or KI interviews, and was not told their results until after all diagnoses were given.

Initiative (https://www.darwininitiative.org.uk/) as part of a successful application to fund health service introduction into the Wanang Conservation Area. JM authored the resultant health service plan (box 1) in consultation with other Co-Is with health service backgrounds (GC, JAC, ML, SLW). A verbal summary was provided at a village meeting, and this manuscript (with Tok Pisin plain language summary) given to the community's health committee (formed as a result of this assessment).

Changes from our published protocol

On RT advice we additionally interviewed two teachers from the school in Wanang, whose students attend from communities in the surrounding area. We adhered to our protocol's triage for clinical assessments, but additionally issued numbered queue tickets so those 'perceived (by themselves or their parent) to not have an illness'[4] could estimate when their examination would likely take place, so they had the option of leaving and returning. To support comparison with data collected elsewhere JM recoded diagnoses (verified by GC) to International Classification of Diseases 11 (ICD-11).[19] In addition to sex-age FG rankings of health issues and service priorities, we generated all-group rankings by adding inversely weighting ranks (supplementary file, p.3).

Patient and public involvement

The study determined clinical and community priorities as part of co-planning services following community request for healthcare. PNG staff from the province were involved in design, including co-author JP from Wanang. Community members advised on research conduct and burden, aided recruitment, and co-authored this paper.

RESULTS

Participants

Individual consents for clinical assessments were provided for 135 people. Of these, medical history was obtained for 129 (54f, 75m; median 19y, range 1mo–73y) and 113 examined (51f, 62m; median 18y, range 1mo–73y) (table S1, supplementary file, p.3). Data from all were used in analysis. In our

protocol[4] we reported a survey recording 189 individuals (89f, 100m). KIs did not consider there had been major population changes in the intervening two years. Based on this, medical history and examination data would represent 68.3% and 59.8% coverage respectively. Twenty-six ≥18y took part in FGs (sex and age, figure 2), five KIs were interviewed (sex and backgrounds, figure 2). Quotes in roman typeface are translated from Tok Pisin (dual transcripts retained), those in italics are written as spoken. Attributed texts without quotation marks are from patient histories summarised by RTs at the time. Some subjects in the topic guides were not addressed by some FGs and KIs, but for all reported quantitative variables of interest there were no participants with missing data.

Disease burdens

 Key informants and focus groups

All KIs said "malaria" significantly affects their community. Other leading burdens identified were shortness of breath ("sotwin"), tinea imbricata (a superficial fungal infection), cough, and tropical ulcers ("most people in Wanang, they've ulcer on their legs, arms" [KI]). FGs identified 31 health issues affecting their community, ranking top-5's (table 1). These included ethnoclassifications (1) largely imported from biomedical English (e.g., "TB"), (2) trackable to specific biomedical conditions (e.g., "pukpuk" meaning 'crocodile', a reference to body-wide skin scaling pathognomonic of tinea imbricata), and (3) naming signs/symptoms with unspecified aetiology (e.g., "pispis blut", blood in urine). "Malaria" scored highest (top-5 for all FGs, highest for two, second highest for one), followed by "sotwin" (three FGs), cancer (two FGs), and "grile" (i.e., tinea imbricata) (two FGs). Each FG ranked at least one top-5 issue which was not selected by the others. The greatest discordance was between f≥40y and everyone else. They identified "malaria" as a top-5 issue, but ranked it fifth. None of their other top-5s were similarly ranked by others or, except one, listed. They ranked two pregnancy related conditions as top-5s, no others listed any (f<40y and m≥40y identified related service need later in FG discussions). Cancer ranking third was surprising given the community age structure. One male FG participant went as far to say: "now a lot of us here are living with cancer". Interviews indicated concerns partly arose from a recent unexpected death of an influential woman:

"think she is OK but the sickness is inside... we all surprised when we took her to hospital, and go to the x-ray and they said "oh, cancer" (KI).

Tinea imbricata was not identified by f≥40y or <40y as a community health problem, but m≥40y and <40y ranked it a top-5. The latter said it: "tends to occur in children, and also in people like us... older men and older women it just occurs occasionally". The female RT (co-author MJ) recorded the same impression in her fieldnotes based on living in the community. All field staff observed skin ulcers were common in children. Similarly, when watching children in daily life it seemed to MJ many had prolonged coughs, as did older men and women. Three of the team noted smoking tobacco wrapped in newspaper seemed very common amongst adults.

Table 1. Health issues affecting the Wanang community and priorities for service introduction, as identified and ranked by sex-age based focus groups.

Ranked lists were produced using the nominal group technique [16], combined group ranks by reverse weighting (scores in brackets, method, supplementary file, p.3). Italic text is untranslated direct speech, Tok Pisin names/descriptions are given at first use left to right (transcripts retained). Ethnoclassifications of the top four ranked health issues ("*Malaria*", "*Sotwin*", Cancer, "*Grille*") are summarised in the main text, and detailed with quotes in tables S3–6 (supplementary file, p.6–9).

Females <40y	Males <40y	nity, identified and ranked Females ≥40y	Males ≥40y	Combined ranking
Top five health issues, as ra	nked by sex-age focus gr	оир	•	
"Malaria"	"Sotwin"	Lower body painful/stiff*	"Malaria"	"Malaria" (15)
"Sotwin"	"Malaria"	Pregnancy anaemia †	Cancer ‡	"Sotwin" (12)
Lower abdominal pain §	"Grile"	Fish-eye sore	"Sotwin"	Cancer (6)
Cancer ‡	Fever "Skin hot"	Retained placenta ¶	"TB"	"Grile" (4)
Headache "Het pen"	Cough/cold "Kus"	"Malaria"	"Grile"	
Health issues identified by a	ıll sex-age focus group, b	ut not included in their individue	al top fives	
(in top five)	(in top five)	"Sotwin"	(in top five)	
Cough/cold	(in top five)	Cough/c	old	
(in top five)		Headache		
Health issues identified by o	only three sex-age focus g	roups		
	pain/damaged skin "Skir	ı pen"		
Back pain "Baksait pen"			Back pain	
Diarrhoea "Pekpek wara"			Diarrhoea	
(in top five)		Cancer ‡	(in top five)	
Knee pain "Kneepen"		(in top five)	Knee pain	
Stomach-ache "Bel pen"		Stomach-		
Toothache "Tit pen"		Toothack	ne#	
Earache "Ia pen"		Earach		
	Loss of vision "a	i bilong mipela olsem i no save l Sores "Sua"	ukluk gut" (f≥40y)	
Health issue identified by or	nlv two sex-age focus gro	uns		
	Scabies "Kaskas"		Scabies	
Health issues identified by o	only one sex-age focus gr	оир		
Blood in urine "Pispisblut"				
Liver/heart pain "Lewapen"				
	Animal bites Δ			
	Cold sickness ◊			
		Bone sickness "Bun sik"		
		Faint during period **		
			Blocked urine ††	
			Swollen stomach ‡‡	

(b)	(b) Priorities for service introduction, identified and ranked by sex-age based focus groups							
Females <40y		Males <40y Females ≥40y		Males ≥40y	Combined rankings			
1	"Transport"		"Aid Post"		"Aid Post" (15)			
2	Vaccinations "Bebi sut" *	Road "Rot"	Vaccinations	"Family planning"	Vaccinations (11)			
3	"Family Planning"	"Transport"	Perinatal & birth care	Vaccinations	"Transport" (10)			
4	Perinatal & birth care †	"Awareness"	Transport ‡	"Awareness" §	Perinatal/birth (7)			
5	Fracture treatment			Perinatal & birth care	"Family planning"(7)			

(a) * "When we work a lot, our legs tend to get stiff", "Taim mipela wok lot, em lek bilong mipela save tait nambaut". † "In pregnant women, stiff arms and anaemia", "Mama gat bel, na han tait na skin yellow". ‡ f<40y, cervical cancer, "sik bilong Mama"; f≥40y, breast cancer, "Susu cancer"; m≥40y, "breast cancer or cancers inside the body", "susu cancer o cancer bodi insait". § "As bilong bel pain". ∥ "Ai bilong pis". ¶ "Withold bilum bilong pikinini". # "binatang eat the teeth", "binatang kaikai tit". In tok pisin binatang refers to insects and all small living things (apart from mammals) including those invisible, such as bacteria. ∆ "Animol sa kaikai". ◊ "Kol sik". ** "During periods your eye can spin... and you will faint, in this case", "Taim i westim blut ai bilong yu i ken raum... nau olsem ap indai, long dispela". †† "Pispis blok". ‡ "Bel solap sik".(b) * For infants and children. † f<40y, "When women are pregnant, make it easier for them so they don't to travel", "Taim ol mama i gat bel, ol bai no inap go longwe bai isi long karim"; m≥40y, "Helping mothers to give birth", "Helpim ol mama long karim bebi". ‡ "If older women and older men are ill, it's difficult to carry wood to the hospital.", "Ol mama papa sik, had bilong karim ol diwai kam long haus sik". § "awareness about like HIV and AIDS, one example is HIV and AIDS, and tuberculosis, all those − health education". |
"broken necks, arms and bones − to have some way to treat", "nek bruk o han bruk, bun bruk − em bai i gat olsem bai stretim".

Medical histories, clinical assessment, and urgent treatments
Seventy-five participants (40m, 35f; 58.1%, n=129) were reported to have ever had "malaria"; 23
(6f, 17m; 17.8%) "sotwin"; two (1f, 1m; 1.6%) cancer. Thirty-five (12f, 23m; 27.1%) had had
"grile", with other infectious skin conditions also highly represented: skin ulcers, 16 (6f, 10m;
12.4%); scabies, 11 (4f, 7m; 8.5%). No f<18y reported having children or problems during
pregnancy/birth. Of 30 f≥18y, 27 had given birth to live children: 128 in total (mean 4.7 per female
with a child, range 1-14), of which 15 (11.7%) had since died. Nine (33.3%) had experienced
problems during pregnancy/birth. Summary clinical results are illustrated in figure 3 and listed
(disaggregated by sex) against ICD-11 primary and specific codes in supplementary file (table S2,
p.4). Primary categories with the highest diagnoses were 'certain infectious or parasitic diseases' and
'diseases of the respiratory system' (each respectively with 41 diagnoses, 24.4% of the total 168),
followed by 'symptoms, signs or clinical findings, not elsewhere classified' (25, 14.9%). The next
largest grouping was 'well', an evaluation given to just 11 of 113 examined (9.7%). The five most
common diagnosed specific conditions were acute upper respiratory infection (URI)' (25, 22.1% of
those examined), tinea imbricata (15, 13.3%), lower respiratory tract infection (LRTI) (10, 8.8%),
malaria (9, 8.0%), and confirmed or suspected tuberculosis (9, 8.0%). GC noted a wide spectrum of
malaria severity, and <i>Plasmodium falciparum</i> and <i>vivax</i> were both present (mixed in some cases). A
greater proportion of females had URI (16, 31.4%) than males (9, 14.5%), in contrast to tinea
imbricata (11m, 17.7%; 4f, 7.8%) (supplementary table S2). Many diagnoses were only made in one
or two individuals (29.2% of total illness diagnoses, 49 of 168). Sixty-two villagers received urgent
treatments (30f, 32m), 31 (15f, 16m) were referred to Madang hospital for further investigation. ICD-
11 has a 'diseases of the skin' primary category, but many infectious skin diseases are categorised
elsewhere, mainly as 'certain infectious or parasitic diseases'. Figure 3 compensates by outlining in
red infections or parasitic conditions primarily affecting the skin (30 diagnoses, 17.9% of
morbidities). In addition to tinea imbricata (the second most diagnosed illness overall), tropical ulcers,
scabies, yaws, and post-traumatic wound infections were diagnosed. Multiple participants reported
these substantially affected their life because of itch, pain, disruption of sleep and inability to walk.
Concordance
There was generally strong concordance between diagnoses most frequently made following
assessment, medical histories, and the health issues the community identified as being most important
For example, three of FGs top four ranked health issues ([a] "malaria"; [b] "sotwin"; [c] "grile".
Ethnoclassification taxonomies, supplementary tables S3-6, supplementary file, p.6-9), translated to
the five biomedical conditions we diagnosed most ([a] malaria; [b] URI, LRTI, TB; [c] tinea
imbricata. Figure 3). These three FG ranked health issues were also highly represented in declared

medical histories ([a] 75 participants, [b] 23, [c] 35). The remaining of the FGs top four ranked health

issues, cancer, was not similarly mirrored in patient histories or clinical diagnoses given.

Existing disease prevention, treatment, and ethnoclassifications

One KI perceived the community had got healthier over the preceding decade due to changes in the village environment and behaviours, specifically: reduced mosquito populations; introduction of covered pit latrines; improved personal hygiene; enhanced nutrition through diversified cropping. An agronomy trained RT noted "almost everyone makes garden and continues to live a subsistence life". and counted 20 crops under cultivation, supplemented by hunting wild pigs and bandicoot, and fishing. Males ≥40y described preventing diseases through bathing, not eating rotten food, avoiding rain, and not "working too hard". Males <40y also mentioned care when walking in the forest and working with axes and knives. Females <40y focused discussion of prevention on bathing (both oneself and children) and keeping cookware clean. Mosquito nets and bed sheets were often referred to, but participants believed only half of Wanang were thought to have them; no-one reported retreating nets. Villagers said they learned about health from mothers, teachers, and through sharing advice given at aid posts or hospital. Participants reported traditional treatments were made at Wanang, biomedical treatments acquired at a neighbouring area's aid post (now usually closed) or from hospital/pharmacy in Madang town. If diseases were treated, which they were often not, a plurality of treatment approaches were used. Whatever was to hand was used first (usually traditional plant-based medicines or stored pharmaceuticals, sometimes rituals), with individuals only leaving Wanang to obtain medicines for severe or refractory disease. FGs and KIs reported that whilst some people were more skilled in plant-medicines than others, there were no specific medical roles in the community, rather everyone knew something, at least for minor ailments:

"we live in the forest so we have information about all little types of forest medicine... we know to take sap from vines [for] coughs... Diarrhoea too can be treated by medicine from the forest... [but] lower abdominal pain doesn't have a forest medicine... you go out to the hospital" (f<40y FG).

Rituals were reported in a patient history and FGs:

"they use a spell... take cold water from the mountain, do a little ritual and "WHSSHHH!"... they can touch the belly button and stomach will no longer be in pain... Cough/cold... tends to stop it completely" (m<40y).

Ability to conduct such practices was reported to be less common, but not specialised to any age/sex group. Some were more cynical, saying sometimes its "proper, sometimes they pretend", and specifying that in "reality these things like malaria or snake bites... shaman/traditional healer from the village will not be able to sort it out" (m≥40y FG). Notably, someone known for skill with traditional treatments articulated this latter view.

The ward councillor reported no aid posts, patrols, or health NGOs operated in the upper Ramu lowlands; an area he estimated to have c8000 persons. To reach the nearest post:

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3 4	333	"you have to walk for a day sleep there, get treatment and then walk back [but it often
5	334	doesn't have supplies as] whenever there is a lot of medicine everyone from Musak, Kibirai
6 7	335	and Ramu, they all come the medicine tends to run out in one day" (KI).
8	336	Combined with concerns about violence in the neighbouring area, this meant traveling to Madang
9 10	337	town in a Public Motor Vehicle or with Binatang Research Centre was often preferred. Maternal
11	338	mortality is high in PNG, but one KI reported that with road evacuation by Binatang Research Centre:
12 13	339	"in the last five years, not a single mother giving birth died in childbirth. Because we are
14 15	340	safe in the time since conservation work has been occurring, we have [Binatang Research
16	341	Centre] emergency vehicle tends to come and take us" (KI).
17 18	342	However, improvised stretchers were still required transport for ill/immobile individuals to the
19	343	roadhead. KIs and FGs discussed further barriers on reaching the provincial hospital, including that it
20 21	344	often didn't have sufficient supplies:
22	345	"hospitals are running out of medicines, normally they check the patient and send them
23 24	346	to go to the chemist to buy. So you'll see, when people don't have money how will they be
25 26	347	cured" (KI).
27	348	Illiteracy and unfamiliarity with institutions left some unable to navigate the hospital (spatially or
28 29	349	bureaucratically), deterring attendance:
30	350	"sometimes they afraid come to the hospital because most things are written in English" (KI)
31 32	351	"some older women/mothers, they don't tend to go, big hospitals have a lot of wards. When
33 34	352	you go inside, you will go back and forth looking over a lot of areas you will be
35	353	confused making you not want to go to the hospital" (f≥40y).
36 37	354	Without an aid post, villagers lacked formal referrals. Given such barriers, participant medical
38	355	histories and KI reports indicated secondary care attendance was frequently delayed, and clinical
39 40	356	diagnosis and treatment bypassed by purchasing medicines from pharmacies for immediate/future use,
41 42	357	or simply by not seeking biomedical care despite wishing to do so.
43 44	358	Top four health issues identified by FGs as affecting the community
45	359	Ethnoclassification taxonomies for each of the top four health issues identified by FGs are in
46 47	360	supplementary tables S3-6 (supplementary file, p.6-9), including example quotes from KIs, FGs, and
48	361	patient histories on how the diseases are understood, who treats them, and how. Though the belief
49 50	362	"sanguma poison" (sorcery) causes some illness was voiced in the m≥40y FG, they seemed in
51 52	363	agreement that "malaria sores, "sotwin" or that kind of thingare not to do with this." All causes
53	364	given by FGs and KIs for the top four diseases were biological, none mentioned sorcery as causal.
54 55	365	However, two examined participants declared they thought sorcery explained their ailments
56 57	366	("sotwin"; lower body pain), and two others attributed death of some of their children to sorcery.
58 59	367	"Malaria" (table S3, supplementary file, p.6): FGs all used the Tok Pisin and English word
60	368	"malaria", saying everyone can be affected, though some KIs highlighted children and old people as

at particular risk. Mosquitoes were uniformly identified as the "malaria" vector, and linked to sleeping outdoors/without a bed net. However, explanations differed and included biomedically erroneous beliefs (i.e., malaria results from mosquitoes laying their eggs, or transferring pig/dog blood to humans). Listed signs/symptoms aligned with biomedically-labelled malaria. Treatments included doing nothing and resting, "medicine from the forest", pharmacy-drugs, and hospital attendance. Members of f≥40y FG described treatments using steam from boiled plants and fruits. According to the m<40y FG few know how to do this (though it included one of them). One stated pharmaceutical treatment used was amoxicillin which is not an antimalarial drug.[20] A FG and KI described how hospital treatment was sometimes sought for severe cases, using Binatang Research Centre transport when available.

"Sotwin" (table S4, supplementary file, p.7). This Tok Pisin word has a dual meaning as both sign/symptom (shortness of breath), and specific biomedical condition (asthma).[21] Given this, people were likely sometimes describing experiences of conditions beyond asthma (only one case diagnosed on examination). A KI emphasized that without medical support the community cannot differentiate between "TB" or "asthma" for example. On clinical assessment, some who said they had "sotwin" were diagnosed as having respiratory infections, chronic obstructive pulmonary disease, and in one case tuberculosis. Though "TB" was listed by m>40y (and no other FGs) as a specific health issue, given evident conceptual overlap in Wanang due to lack of diagnostic testing to generate a distinct class of tuberculosis cases, the community's classification of "sotwin" can practically speaking be taken to include "TB" (considered further in discussion). Most FGs, and some KIs, said "sotwin" affected all parts of the community. Others highlighted risk to >5y and youth, or older ages. Causes stated were diverse: smoking; chewing betel nut; cooked meat/fish, or contaminated containers; sex with women (mentioned by both male FGs); proximity to others; rubbish and dust; the sun. Associated signs and symptoms included heavy breathing, difficulties during exercise, and coughing. Some patients presenting with "sotwin" had had no prior treatment, others had used pharmacy drugs. Plant-based oral treatments were described; one person stated child cases could be healed in the village, another that forest medicines usually only work temporarily for "sotwin".

Cancer (table S5, supplementary file, p.8): Three Tok Pisin named cancer types were identified by participants: "susu cancer" (breast cancer), "cancer bodi insait" (cancers inside the body), and "sik bilong ol mama" (cervical cancer). The m≥40y FG was particularly concerned. When asked who is affected, they answered both "a lot of us" and "we don't know ourselves". Such a combination of high concern and declared powerlessness permeated statements about cancer by all those who discussed it. Unlike all other conditions, cancer was uniformly described as something only distant doctors could see or treat. Badly prepared meat and fish, smoking tobacco, and chewing betel nut were given as causes. Females <40y were "not sure" of what brings about cervical cancer. Though coughing and flushed skin were mentioned as signs of cancer, the main message was "we find out from the doctor".

 A linked stated issue was that without primary care to assess community members and provide hospital referrals, subsequent therapy was thought likely to come too late. This was powerfully voiced by one KI whose mother had recently died of cervical cancer after protracted delayed diagnosis. Fear of medical interventions was also seen as a barrier to "cure".

"Grile" (tinea imbricata) (figure 4; table S6, supplementary file, p.9): Also known as "Kavnam" and "Pukpuk". All ages and sexes were said to be affected, younger groups especially (a teacher stated most of her schoolchildren). A f≥40y said she and many others like her hide it. People associated grile with continuing to wear clothes sodden from bathing/rain/sweat. Rivers contaminated with "crocodile skin particles" from affected people bathing or washing clothes upstream were believed by a KI and both male FGs to be responsible. Male FGs and affected individuals associated sharing clothes and co-sleeping with transmission. Differing within-community susceptibility was also suggested (which is in line with observations that predisposition seems to be linked to recessive inheritance [22]). Signs and symptoms reported were "skin like crocodile" (body-wide), scratching, itch, pain. Treatments included local plants (lime, peppers, tree bud paste; heated tree seeds; papaya) and biomedicine from chemists/hospitals (tolnaftate cream; oral terbinafine). Remission post-treatment was expected, and many go entirely untreated. One m<40y described a traditional practice he'd used: "take a knife and make a hole in a banana plant... put the skin infected with pukpuk inside... now it ends their pukpuk... there is no spoken words or anything". Others listening said this is not a method they use now.

Community identified priorities for health service provision

Table 1 b shows FG identified priorities for service introduction. The highest scoring was aid post sited in Wanang, top for all but f<40y who thought it an unrealistic expectation from government so did not list it. The ward councillor confirmed one had been requested previously but never delivered. KIs were not asked to rank priorities but all strongly called for aid post establishment. For example:

"this is remote area, so the best thing is we must have a aid post. We must because we have too many sicknesses here... [and] there is no hospital or clinic around... an aid post will... benefit many people... That's what we want, we are a community and we are thinking about this for us" (KI).

Child vaccinations ranked next highest, identified by three FGs, but not m<40y. Transport was ranked first by f<40y, a priority by two other FGs. Pregnancy and birth care within the community was vocalised by female FGs and m≥40y, but not m<40y. Jointly scoring with pregnancy and birth care was family planning, identified by f<40y and m≥40y (the latter ranking it their second highest priority). One KI stated people would welcome family planning services to enable increased birth spacing and reduced family sizes:

"they got no times for body to rest... If they go over six, seven, eight, nine, and ten, that's too much... it's very expensive... to buy clothes and school fee and... for their safety, three children to a father and mother, or four or five, it's enough" (KI).

Whilst not a combined top five, both male FGs ranked health education as a top five (specifically HIV and TB awareness), but neither female FG did. Given opportunity only m≥40y and f<40y identified five priorities (the latter adding fracture management).

DISCUSSION

Principal findings

We established service needs of the community by determining disease burdens and voiced service priorities. Of 113 examined, only 11 were 'well', 62 treated urgently, 31 referred, indicating considerable unmet need. FGs top four ranked health issues strongly concorded with KI views, medical histories, and clinical examinations. For example, ethnoclassifications of three ([a] "malaria", [b] "sotwin", [c] "grile") translated to the five biomedical conditions we diagnosed most ([a] malaria, [b] URI, LRTI, TB, [c] tinea imbricata), and were highly represented in declared medical histories. We built a picture of existing disease prevention and treatment, including who community members think are affected by each of the top four, how they recognise them, what they think causes them, and how they are treated and by whom (answering our subsidiary research questions). FGs generally ascribed their top health issues biological explanations but not always correct ones. Treatment was pluralistic, with whatever was to hand used first (usually plant-medicines/stored pharmaceuticals, sometimes rituals), and travel to hospital/pharmacy reserved for severe/refractory disease. Plantmedicines were considered common knowledge, healing rituals less so. Stated barriers to biomedical services included: no local health patrols or easily reachable aid post; remote town hospital; unfamiliarity with institutions; medicine costs. Given these barriers, attendance was frequently delayed, clinical diagnosis and treatment bypassed by purchasing familiar (not always appropriate) drugs from pharmacies for immediate/future use, or biomedical care was simply not sought (despite stated desire). FG health service priorities were: aid post, child vaccinations; transport; pregnancy and birth care; family planning; health education; fracture management. We successfully used the study's findings to secure funding to establish such services, and target some of the lead health issues identified.

Strengths and weaknesses

Study strengths include its cost-effective time frame, and a mixed-method approach that increases confidence in findings by triangulating qualitative and quantitative data. However, speed was also a limitation as we inevitably overlooked social nuance that slower ethnography may have identified. KI selection was biased towards highly influential, mostly male individuals in Wanang to obtain perspectives of those with influence who could facilitate or block interventions. However, this

 limitation is balanced by individual clinical discussions and age-sex segregated FGs, across which most adult villagers participated. Importantly, these provided opportunity to talk freely, unobserved by fellow-villagers from other sexes or age-groups. We examined most of the population of Wanang but loss of some of those triaged towards the end of a multi-day queue is likely to have biased the sample towards those with greater morbidity. In our protocol paper[4] we describe strengths and weaknesses of rapid anthropological assessment procedures in health research including those of our study. Many previous studies using this methodology have been based on disease prioritisations set by global 'vertical health programmes' [23] (e.g., HIV, guinea worm [13]). In contrast, our research was initiated following a community request, better supporting community-led service planning. Our broad focus reduces capacity to detect some health burdens as accurately as single-disease targeted research. A strength compared to assessments without clinical components, was parallel treatment of urgent cases. Collecting data on Wanang's health burdens can be expected to benefit those of us employed as professional researchers and our institutions. Health service implementation had not been secured at the time of data collection and treatment provision went someway to making the relationship between the community and researchers a fair transaction, rather than one of dispossession and accumulation as West[24] has characterised some foreign-driven research and NGO activity in PNG.

Ours is the only health assessment of Wanang village, and the most comprehensive study of a community's general health in the rainforests of Madang province. Many high burden illnesses reflect those seen nationwide (e.g., GBD 2019 ranks respiratory infection as the leading cause of all-age PNG DALYs[25]) and community perspectives and ethnoclassifications resonate with some voiced elsewhere (particularly Whittaker et al.[26]), however we caution against extrapolating beyond Wanang. PNG is hugely diverse culturally (it has more languages than any other nation on earth[27]) and biogeographically (lowland forests, peri-urban slums, swamplands, high mountains, island archipelagos), and its communities have markedly different levels of engagement with state, industry, and the money economy. The myriad eco-cultural 'entanglements' (in the sense used by Nading[28] and Tsing[29]) resulting from these diversities militate against generalisations about PNG's disease ecologies. Nevertheless, given this kind of health assessment is otherwise absent in the region, our results may be usefully indicative of similar settings elsewhere in inland Madang province in communities to which biomedical care remains remote. For insights into relations within and around a hospital in Madang town, see Street[11]. In conclusion, whilst generalisability is limited, given participation levels and composition the sample is representative of Wanang sufficient to fulfil the study aim (to co-plan health service incorporation into the conservation collaboration), and given this kind of health assessment is otherwise absent in the region our results imply substantial unmet medical needs might be found in other forest communities across Madang Province.

Implications for clinicians and policymakers

Wanang health service plan

Health needs assessments commonly make recommendations for clinicians or policymakers to act on identified needs. However, here there were no clinicians providing in-community care to advise, and no expectation from participants that local government would act to establish such services. Given this, any intervention would be by the conservation collaboration itself, and thus this exercise had always been understood as a process by which the community and its academic allies in the collaboration co-plan action together. We outline here the plan for health service introduction developed, and its rationale. Based on clinical observations and voiced community perspectives, targeting malaria, respiratory issues, tinea imbricata, and maternal and child health were clear priorities. Disease-specific actions such as bed-nets, high vaccination coverage, and Mass Drug Administration (MDAs) carried out without permanent infrastructure or staffing could potentially reduce these burdens. However, there was clear community demand for a full-time staffed aid post, and our assessment was that the most effective and sustainable treatment of these burdens would necessitate permanent biomedical health provision sited within the community. This could improve diagnostic certainty and medicine supply, and provide clinician-led treatment, follow-up, and referrals. In addition, while examinations confirmed community-identified health issues were key burdens, over a quarter of diagnoses were for conditions seen in only one or two people. This argued strongly for a holistic primary care approach, rather than just targeting high-prevalence diseases. We concluded to set-up an aid post at Wanang, yet given this could be expected to take time and our assessment demonstrated substantial health burdens, 'holding action' was needed to empower community members to act on identified needs in the meantime. Once established, the aid post could be used as a base for proactive measures in the surrounding communities, targeting the high priority burdens identified here, rather than providing responsive-only treatment. Our plan thus has threephases (figure 4; detailed in box 1), with on-road evacuation from trailheads continuing to be provided by Binatang Research Centre when possible.

Phases 1 and 2 are complete. We used this study's evidence to obtain Darwin Initiative (https://www.darwininitiative.org.uk/) funding for aid post construction, supply, and nurse staffing as part of a 3-year integrated health and conservation project.[30] As holding action, in 2019 first author JM returned to Wanang and trained community members in off-road medical evacuation, and self-treatment of malaria, tinea imbricata, and fractures (figure 4). The aid post was then built and opened at end of 2020, registered with the provincial health authority, and continues to be staffed by a full-time nurse (figure 4). Given PNG's health care shortages, Wanang's population wouldn't be large enough to secure government financial support after project funding ends. However, the total population of the communities including Wanang in the government ward area is c2000 people. Thus, the establishment of an aid post at Wanang was in line with aspirations of PNG's Medium-Term

Development Plan, which aimed to have an aid post operational in every ward, serving populations of
up to c2000 people each[7]. The provincial health authority has undertaken to fund the nurse's salary
and aid post supplies at the end of the Darwin Initiative funding, ensuring the long-term sustainability
of this health service initiative.

Integrating action on health and conservation

As well as supporting the conservation community at Wanang, the establishment of an aid post powerfully demonstrated to surrounding communities the benefits of forest preservation, directly leading new clans to join the collaboration and commit to refuse secondary logging of regenerating previously selectively logged forest (expected to commence 2025). This has directly resulted in expansion of the conservation area from 100 km² to 150 km². Beyond the direct findings of our health needs assessment, this then has implications for policymakers and others looking to identify innovative ways to make progress on the Sustainable Development Goals (SDGs), which are mostly implemented individually[31]. The impacts of this work indicate simultaneously addressing health (SDG 3) and biodiversity (SDG 15) can be a successful 'synergy driver'[31] to advance SDGs. We welcome conversations with anyone who wishes to take such integrated approaches.

Challenges of translating between ethnoclassifications and biomedicine

An implication of our study for clinical researchers is to play close attention to meanings within local disease terms/ethnoclassifications, not leaning too heavily on simple linguistic translation to biomedical diagnostic categories. As "sotwin" illustrated, ethnoclassification terms may hold dual meanings as both symptom/sign and specific medical conditions. Straight-forward translation as asthma would have hidden that participants were describing a constellation of respiratory illnesses (as examinations confirmed). Risk of false conflation may be especially high when ethnoclassification terms resemble or are identical to biomedical ones, such as with 'tibi', which is sometimes used for severe respiratory conditions other than pulmonary TB/tuberculosis.[32] Similarly, "malaria" may seem simple to translate; the Tok Pisin dictionary definition of "malaria" equals malaria in English. [21] However, in practice it is often used generally to mean fever. [26] This is clinically important as non-malarial febrile illnesses are widespread in PNG,[33] underlining the potential value of RDTs in determining when "malaria" is malarial, to avoid inappropriate treatment (which is common [34]). Translational issues between ethnoclassifications and biomedicine are particularly prevalent in PNG, [26, 35, 36] but are found generally. We suggest publications from similar settings (specifically those seeking to (1) describe community perspectives on diseases, or (2) generate nonclinically corroborated prevalence estimates from community surveys) state more often how meanings encoded in local terms have been translated into biomedical categories (and vice versa).

Unanswered questions and future research

Long-term ethnography could improve understanding of disease ethnoclassifications, especially beyond the 'top four'. Studies to determine effectiveness of traditional treatments would be helpful (we discuss ethical issues elsewhere[30]). An audit of the now established aid post would support further development, and given its large catchment area beyond Wanang village could aid determination of how representative this study's findings are of surrounding forest communities. Comparison with health data from communities elsewhere (which in the last few years have started to be nationally pooled [37]) may usefully indicate commonalities and differences. Implementation studies of planned disease specific interventions would be useful service evaluations, potentially with wider value. This may be particularly so for action on neglected tropical skin diseases, which are highly prevalent across the Pacific.[38] The region has been key to developing integrated skin interventions to control scabies and reduce soft tissue infections.[39] Tinea imbricata, which is only found in a small number of populations worldwide but is highly distributed across Melanesia,[40, 41] has been neglected as regards research and treatment [22]. An integrated skin intervention[42] in Wanang and surrounding areas, targeting tinea imbricata alongside yaws, tropical ulcers and scabies (figure 4), may relieve considerable suffering, and act as a model for the region and beyond.

Box 1: Community Health Plan for Wanang Conservation Area

Phase 1: Training and supplies to support community members acting on needs before aid post establishment: (i) malaria treatment (including RDTs, appropriate medications, evacuation triggers), (ii) fracture management, (iii) off-road medical evacuation, (iv) tinea imbricata treatment.

Phase 2: Construct, supply, and staff an aid post to introduce responsive primary care, managed by a community health committee with equal sex representation and involvement of those who have provided traditional treatments. Obtain provincial health authority aid post registration and commitment to provide supplies and nurse salary beyond grant period. In addition, the nurse should facilitate childhood vaccinations, and pregnancy and emergency birth care (with telemedicine-based support). To support continuity of care (and treatment auditing) patient-level data should be recorded and securely stored at the aid post, in addition to individually retained health books.

Phase 3: Once established, the aid post should conduct disease specific interventions and mobile patrols (reaching c2000 people), acting on identified community health burdens and service priorities (in addition to routine treatment). Specifically, (i) Malaria: mosquito net audit, supply, and re-treatment; elsewhere ivermectin MDAs have reduced vector populations and thus human cases, [45] local trials may be beneficial, particularly combined with MDAs on neglected tropical skin diseases already including ivermectin (see iv). (ii) Respiratory issues: preventive child vaccinations; TB screening and referrals; RDTs should guide appropriate treatment given PNG wide shifts from bacterial to viral lung infections and pneumonia. (iii) Cancer: in addition to aid post referrals, preventive (both-sex) HPV vaccinations could be introduced (if supplies imported) as PNG has a higher-than-average burden of cervical cancer for comparable nations and it is thought to be the second leading cause of cancer in the country. [46–48] (iv) Tinea imbricata and other skin infections: joint-MDAs and targeted follow-ups for yaws, tinea imbricata, impetigo, and scabies; introduction of ethnomedicine treatments for tropical ulcers already trialled elsewhere in PNG.[49] (v) Family planning: facilitate Marie Stopes mobile clinic visit. (vi) Pregnancy related anaemia: birth spacing; other solutions are not evident given local genetic predisposition to anaemia is partially protective against malaria, and iron supplementation can be expected to have negative impacts while infection rates remain high. [50, 51] (vii) Health education: nurse-provided STD training sessions; exercises for youth to reduce sports related lower back pain. (viii) Mobile patrols: nurse-led patrols to reach villages across the aid post catchment area.

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595	STATEMENTS
596	Supplementary file: Th

Supplementary file: This web only file has been produced by the BMJ Publishing Group from an electronic file supplied by the authors and has not been edited for content.

Contributors: Author order is alphabetical by surname, except first and last. Co-Investigator backgrounds are detailed in the methods section, and in line with recommendations from Utarini et

al.,[13] we also detail relevant prior experience of the fieldwork team (supplementary file, p.3).

Contributions to this publication are outlined using the CRediT Contributor Taxonomy

(https://credit.niso.org), and research assistants (RAs), technicians (RTs), and collaborators (C)

flagged at first appearance. Conceptualization: JM, GC, JF, MGH, JI, HM, VN, MP, AJS, SLW, JAC.

Data curation: JM, GC, AE(RA), RH(RA). Formal analysis: JM. Funding acquisition: JM, GC, JF,

MGH, JI, ML, HM, VN, MP, WP, AJS, SLW, JAC. Investigation: JM, GC, MJ, JP(RT), SS(RT).

Methodology: JM, GC, FD, JF, MGH, JI, MJ, CIJ, ML, HM, VN, MP, JP, WP, SS, AJS, SLW, JAC.

Project administration: JM. Supervision: JAC, AJS. Visualisation: JM, JP(RT). Writing—original

draft: JM. Writing—review and editing: JM, GC, FD, AE, JF, RH, MGH, JI, MJ, CIJ, ML, HM, VN,

MP, JP, JP, WP, JAS(C), SS, AJS, RU(RT), SLW, JAC. All authors reviewed the study findings and

read and approved the final version before submission. JM is responsible for the overall content as

guarantor, and attests all listed authors meet authorship criteria and no others meeting the criteria have

been omitted.

Ethics: This study involves human participants and was approved by PNG Institute of Medical

Research Institutional Review Board, PNG Medical Research Advisory Committee (MRAC18.06),

and Brighton and Sussex Medical School Research, Governance, and Ethics Committee

(ER/BSMS61566/1). Community consent[43] was obtained though speaking to clan leaders, and a

mass village meeting. Individual consent was provided for participation in FGs, KI interviews, and

individual primary care assessments. Acute medical needs and absence of local health services risked

participation would not be truly voluntary. Thus, to avoid conditionality through passive coercion[44]

villagers were offered examinations and treatments without requirement to participate in the study.

We discuss related ethical issues in our published study protocol.[4]

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- 631 Abdad (Papua New Guinea Institute of Medical Research, PNG), Emilie Beauchamp (International
- 632 Institute for Environment and Development, UK), Maxwell J F Cooper (Brighton and Sussex Medical
- School, UK), Caroline L Grundy (University of Sussex), Martina Konecna (University of South 633
- 634 Bohemia), and Chrissy H Roberts (London School of Hygiene and Tropical Medicine).
- Data availability: All data relevant to the study are included in the article or uploaded as 635
- supplementary information, bar individual-level data from primary care assessments and full 636
- 637 interview/group transcripts (neither of which can be sufficiently anonymised for publication given the
- 638 study's small named community).
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REFERENCES

- 1. Lim SS, Allen K, Bhutta ZA, et al. Measuring the health-related Sustainable Development Goals 647 648 in 188 countries: a baseline analysis from the Global Burden of Disease Study 2015. Lancet 649 2016;**388**:1813–50. https://doi.org/10.1016/S0140-6736(16)31467-2
- 650 2. Shearman P, Bryan J. A bioregional analysis of the distribution of rainforest cover, deforestation 651 and degradation in Papua New Guinea. Austral Ecology 2011;36:9–24.
- https://doi.org/10.1111/j.1442-9993.2010.02111.x 652
- 3. Novotny V, Toko P. Ecological research in Papua New Guinean rainforests: Insects, plants and 653 654 people. In: Bryan JE, Shearman PL, eds. The state of the forests of Papua New Guinea 2014:
- Measuring change over period 2002–2014. Port Moresby, Papua New Guinea: University of 655
- 656 Papua New Guinea 2015:71-85.
- 657 4. Middleton J, Abdad MY, Beauchamp E, et al. Health service needs and perspectives of remote
- forest communities in Papua New Guinea: study protocol for combined clinical and rapid 658
- anthropological assessments with parallel treatment of urgent cases. BMJ Open 2020;10:e041784. 659
- 660 https://doi.org/10.1136/bmjopen-2020-041784
- 5. Thomas H. The Expedition as a Cultural Form: On the Structure of Exploratory Journeys as 661
- Revealed by the Australian Explorations of Ludwig Leichhardt. In: Thomas H, ed. Expedition 662

- into Empire: Exploratory Journeys and the Making of the Modern World. New York: Routledge 2019:65–97.
- 665 6. Hviding E, Cato B, eds. The Ethnographic Experiment: A.M. Hocart and W.H.R. Rivers in Island
 Melanesia, 1908. New York and Oxford: Berghahn Books 2014.
- 7. Grundy J, Dakulala P, Wai K, *et al.* Papua New Guinea Health System Review (Vol. 9, No.1).
 New Delhi: World Health Organization, Regional Office for South-East Asia 2019.
- 8. Brown AN, Gilbert B. The Papua New Guinea medical supply system: documenting opportunities and challenges to meet the Millennium Development Goals. *J Pharm Policy and Pract* 2014:7.
- https://doi.org/10.1186/2052-3211-7-5
- 9. Stewart A, Peck M, Novotny V. Final report to the Waterloo Foundation (July 2016): Creating
 sustainable livelihoods whilst protecting rainforest in Papua New Guinea (PNG) from logging.
- Falmer, UK: University of Sussex, 2016.
- 10. Stockdale J, Cassell JA, Ford E. "Giving something back": A systematic review and ethical
 enquiry into public views on the use of patient data for research in the United Kingdom and the
 Republic of Ireland. *Wellcome Open Res* 2019;3.
- https://doi.org/10.12688/wellcomeopenres.13531.2
- 11. Street A. Biomedicine in an unstable place: Infrastructure and personhood in a Papua New
 Guinean hospital. Durham: Duke University Press 2014.
- 12. Middleton J, Cassell JA, Novotny V, *et al.* Surfaces: an interdisciplinary project to understand and
 enhance health in the vulnerable rainforests of Papua New Guinea. Inaugural Planetary Health /
 GeoHealth Annual Meeting, 28–30 April 2017, Harvard Medical School, Boston, USA. Available
- GeoHealth Annual Meeting, 28–30 April 2017, Harvard Medical School, Boston, USA. Available from: http://sro.sussex.ac.uk/67423 (accessed 18 September 2022).
- 13. Utarini A, Winkvist A, Pelto G. Appraising studies in health using rapid assessment procedures
 (RAP): Eleven critical criteria. *Hum Organ* 2001;60:390–400.
 https://doi.org/10.17730/humo.60.4.3xu3p85amf13avtp
- 14. Institute of Development Studies Participation Research Cluster. Resources [Internet]. 2022 [accessed 28 August 2022]. https://www.participatorymethods.org/resources.
- 15. Middleton J, Abdad MY, Beauchamp E, *et al.* Supplemenary File for Health service needs and
 perspectives of remote forest communities in Papua New Guinea: study protocol for combined
 clinical and rapid anthropological assessments with parallel treatment of urgent cases. *BMJ Open* 2020;10. https://bmjopen.bmj.com/content/bmjopen/10/10/e041784/DC1/embed/inline-supplementary-material-1.pdf?download=true
- 695 16. Gallagher M, Hares T, Spencer J, et al. The Nominal Group Technique: A Research Tool for
 696 General Practice? Fam Pract 1993;10:76–81.
- 17. Scrimshaw S, Hurtado E. Rapid assessment procedures for nutrition and primary health care:
 Anthropological approaches to improving programme effectiveness. Los Angeles: University of
- 699 California 1987.

- 18. Goldsmith, LJ. Using Framework Analysis in Applied Qualitative Research. *Qual Rep* 2021;26:2061–2076. https://doi.org/10.46743/2160-3715/2021.5011
- 19. WHO. International Classification of Diseases (11th Revision) for Mortality and Morbidity
- Statistics (Version: 02/2022). Geneva: World Health Organization 2022. Available at:
- https://icd.who.int/browse11/l-m/en (accessed 16 July 2022).
- 20. Sié A, Dah C, Ourohiré M, *et al*. Azithromycin versus Amoxicillin and Malarial Parasitemia
 among Children with Uncomplicated Severe Acute Malnutrition: A Randomized Controlled Trial.
- 707 A J Trop Med Hyg 2021;**106**:351–355. <u>https://doi.org/10.4269/ajtmh.21-0595</u>
- 708 21. Volker CA, ed. Papua New Guinea Tok Pisin English Dictionary. Melbourne: Oxford University
 709 Press 2008.
- 710 22. Er YX, Lee SC, Than LT-L, et al. Tinea Imbricata among the Indigenous Communities: Current
- Global Epidemiology and Research Gaps Associated with Host Genetics and Skin Microbiota. J
- 712 Fungi 2022; 8:202. https://doi.org/10.3390/jof8020202
- 713 23. De Maeseneer J, van Weel C, Egilman D, et al. Strengthening primary care: addressing the
- disparity between vertical and horizontal investment. *Br J Gen Pract* 2008;**58**:3–4.
- 715 <u>https://doi.org/10.3399/bjgp08X263721</u>

- 716 24. West P. Dispossession and the Environment: Rhetoric and Inequality in Papua New Guinea. New
- York and Chichester: Columbia University Press 2016.
- 718 25. Institute for Health Metrics and Evaluation. GBD (Global Burden of Disease) Compare Tool,
- Papua New Guinea. Both sexes, all ages, 2019, DALYs. Washington.
- 720 <u>https://vizhub.healthdata.org/gbd-compare/</u> (accessed 21 Oct 2022).
- 721 26. Whittaker M, Piliwas L, Agale J, et al. Beyond the Numbers: Papua New Guinean Perspectives
- on the Major Health Conditions and Programs of the Country. *PNG Med J* 2009;**52**:96–113.
- 723 <u>https://search.informit.org/doi/10.3316/informit.300656919646201</u>
- 724 27. Novotny V. Island of a thousand tongues and a wild, wild landscape. In: Notebooks from New
- 725 Guinea: reflections on life, nature, and science from the depths of the rainforest. Oxford: Oxford
- 726 University Press 2011:11–51.
- 727 28. Nading, AM. Humans, animals, and health: from ecology to entanglement. *Environ Soc*
- 728 2013;4:60–78. https://doi.org/10.3167/ares.2013.040105
- 729 29. Tsing AL. Enabling entanglements. In: The mushroom at the end of the world: on the possibility
- of life in capitalist ruins. Princeton and Woodstock: Princeton University Press 2015: vii-xiii.
- 731 <u>https://doi.org/10.2307/j.ctvc77bcc</u>
- 732 30. Middleton J, Cassell JA, Colthart G, et al. Rationale, experience and ethical considerations
- underpinning integrated actions to further global goals for health and land biodiversity in Papua
- 734 New Guinea. Sustain Sci 2020;15:1653–1664. https://doi.org/10.1007/s11625-020-00805-x

- - https://doi.org/10.1016/0160-7987(81)90023-5

- - - 2013;14:29. https://doi.org/10.1186/1472-6939-14-29 23 May 2023 - j.middleton@bsms.ac.uk

- 31. Alcamo J, Thompson J, Alexander A., et al. Analysing interactions among the sustainable development goals: findings and emerging issues from local and global studies. Sustain Sci 2020;15:1561–1572. https://doi.org/10.1007/s11625-020-00875-x
- 32. Hamnett MP, Connell J. Diagnosis and cure: The resort to traditional and modern medical practitioners in the North Solomons, Papua New Guinea. Soc Sci Med-Med 1981;15:489–498.
- 33. Saweri OPM, Hetzel MW, Mueller I, et al. The treatment of non-malarial febrile illness in Papua New Guinea: findings from cross sectional and longitudinal studies of health worker practice.
- BMC Health Serv Res 2017;17:10. https://doi.org/10.1186/s12913-016-1965-6
- 34. Joshua IB, Passmore PR, Parsons R, Sunderland VB. Appropriateness of prescribing in selected healthcare facilities in Papua New Guinea. Health Policy Plann 2014;29:257-65. https://doi.org/10.1093/heapol/czt012
- 35. Lewis G. The ethnography of an illness. In: A failure of treatment. Oxford: Oxford University
- Press 2005:1-16. 36. Frankel S, Lewis G, eds. A Continuing Trial of Treatment: Medical Pluralism in Papua New
- Guinea. Dordrecht: Kluwer Academic Publishers 1989. 37. Rosewell A, Shearman P, Ramamurthy S, Akers R. Transforming the health information system
 - using mobile and geographic information technologies, Papua New Guinea. Bull World Health Organ 2021;99:381–387. http://doi.org/10.2471/BLT.20.267823
- 38. Kline K, McCarthy JS, Pearson M, Loukas A, Hotez PJ. Neglected Tropical Diseases of Oceania:
- Review of Their Prevalence, Distribution, and Opportunities for Control. PLoS Negl Trop Dis
- 2013;7: e1755. https://doi.org/10.1371/journal.pntd.0001755
 - 39. Middleton J. Can ivermectin mass drug administrations to control scabies also reduce skin and soft tissue infections? Hospitalizations and primary care presentations lower after a large-scale
 - trial in Fiji. Lancet Reg Health West Pac 2022;22:100454.
 - https://doi.org/10.1016/j.lanwpc.2022.100454
 - 40. Bonifaz A, Archer-Dubon C, Saúl A. Tinea imbricata or Tokelau. Int J Dermatol 2004;43:505-510. https://doi.org/10.1111/j.1365-4632.2004.02171.x
 - 41. Angra K, Norton SA. Early Western observations of cutaneous Trichophyton concentricum infection in the Pacific and a history of its vernacular name, tokelau. Australas J Dermatol 2016;**57**:e108–11. https://doi.org/10.1111/ajd.12322
 - 42. Engelman D, Fuller LC, Solomon AW, et al. Opportunities for Integrated Control of Neglected Tropical Diseases That Affect the Skin. Trends Parasitol 2016;32:843-854.
 - https://doi.org/10.1016/j.pt.2016.08.005
 - 43. Laman M, Pomat W, Siba P, et al. Ethical challenges in integrating patient-care with clinical research in a resource-limited setting: Perspectives from Papua New Guinea. BMC Med Eth

- Cambridge: Cambridge University Press 2008. https://doi.org/10.1017/CBO9780511545566.003
- 45. Foy BD, Alout H, Seman JA, et al. Efficacy and risk of harms of repeat ivermectin mass drug
- administrations for control of malaria (RIMDAMAL): a cluster-randomised trial. *Lancet*
- 776 2019;**393**:1517–1526. https://doi.org/10.1016/S0140-6736(18)32321-3
- 46. Nguyen DTN, Simms KT, Keane A, et al. Towards the elimination of cervical cancer in low-
- income and lower-middle-income countries: modelled evaluation of the effectiveness and cost-
- effectiveness of point-of-care HPV self-collected screening and treatment in Papua New Guinea.
- *BMJ Global Health* 2022;7:e007380. <u>http://dx.doi.org/10.1136/bmjgh-2021-007380</u>
- 47. Kelly-Hanku A, Newland J, Aggleton P, et al. HPV vaccination in Papua New Guinea to prevent
- cervical cancer in women: Gender, sexual morality, outsiders and the de-feminization of the HPV
- vaccine. *Papillomavirus Res* 2019;**8**:100171. https://doi.org/10.1016/j.pvr.2019.100171
- 48. ICO/IARC Information Centre on HPV and Cancer. Papua New Guinea Human Papillomavirus
- and Related Cancers, Fact Sheet 2021. Barcelona,
- https://hpvcentre.net/statistics/reports/PNG_FS.pdf
- 49. Prescott TAK, Homot P, Lundy FT, et al. Tropical ulcer plant treatments used by Papua New
- Guinea's Apsokok nomads. *J Ethnopharmacol* 2017;**205**:240–245.
- 789 <u>https://doi.org/10.1016/j.jep.2017.05.001</u>
- 50. Oppenheimer SJ, Hill AV, Gibson FD, Macfarlane SB, Moody JB, Pringle J. The interaction of
- alpha thalassaemia with malaria. *Trans R Soc Trop Med Hyg* 1987;**81**:322–6.
- 792 <u>https://doi.org/10.1016/0035-9203(87)90253-7</u>
- 51. Oppenheimer SJ, Gibson FD, Macfarlane SB, et al. Iron supplementation increases prevalence
- and effects of malaria: report on clinical studies in Papua New Guinea. Trans R Soc Trop Med
- *Hyg* 1986;**80**:603–12. https://doi.org/10.1016/0035-9203(86)90154-9

FIGURES

- 797 Figure 1 Study setting.
- 798 A: Wanang community. B: Overgrown logging road on the way to Wanang. C: Wanang area. D: Mural
- honouring the role of aid posts in PNG medicine on the wall of Madang Provincial Hospital. E & F: Examples
- of individual health books in-use in-region at the time of this assessment. [Images: A, New Guinea Binatang
- Research Centre; C, co-author JP; others, first author JM].
- Figure 2 Methodological approach, participants, and resulting plan of health service provision.
- Green boxes are outputs: dark, delivered as part of this assessment; light, requiring additional funding for
- provision. Role abbreviations: PC HCP, primary care health care professional (in this assessment a General
- Practitioner); RTs, research technicians; RF, research fellow.
- Figure 3 Clinical results of primary care assessments at Wanang.

113 Wanang villagers examined (51 females, 62 males), 168 diagnoses given (not including 11 classifications of 'well'). The proportion of each concentric circle relates to the proportion a diagnosis was given as part of the total number of diagnoses, with categories arranged clockwise high to low. The inner circle shows ICD-11 primary categories, the outer circle ICD-11 specific conditions (or ICD-11 symptoms/signs/clinical findings) with number of diagnoses given for each. Infections/parasitic conditions primarily affecting skin are outlined in red. * Developmental. † Ear/mastoid process. ‡ Factors influencing health status/contact with services. § Mental, behavioural or neurodevelopmental disorders. ¶ External causes of morbidity/mortality.

Figure 4. Phased health service introduction at Wanang.

Top: Examples of training provided, (left to right) fracture management, off-road vacuum-stretcher evacuation, use of malaria RDTs. Middle: Wanang Aid Post (left) and nurse consultation (right). Bottom: Examples of disease targets for proactive integrated interventions, specifically (left to right) tropical ulcer, yaws, tinea imbricata, scabies mite and eggs. Images from Wanang, apart from *Sarcoptes Scabiei* microscopy (Credit: top and bottom, JM; middle, Binatang Research Centre).

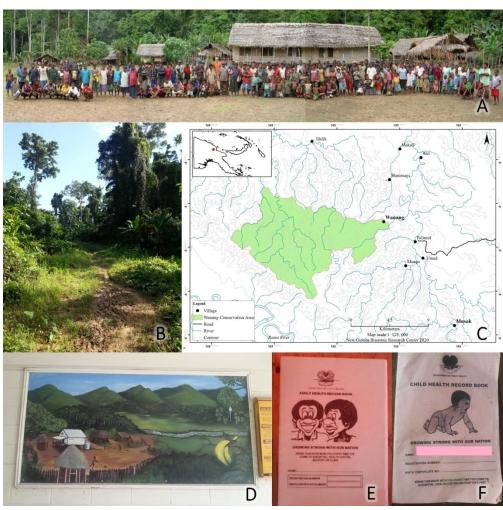


Figure 1 Study setting. A: Wanang community. B: Overgrown logging road on the way to Wanang. C: Wanang area. D: Mural honouring the role of aid posts in PNG medicine on the wall of Madang Provincial Hospital. E & F: Examples of individual health books in-use in-region at the time of this assessment. [Images: A, New Guinea Binatang Research Centre; C, co-author JP; others, first author JM].

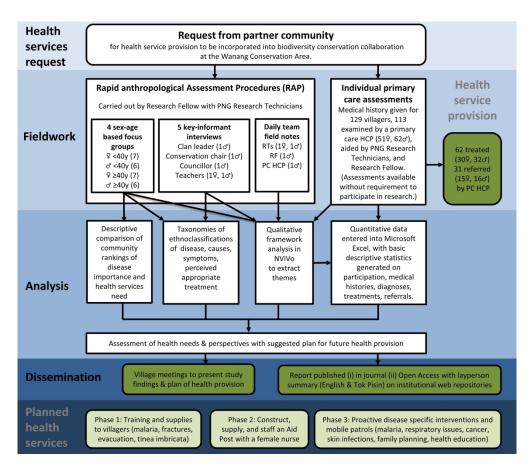


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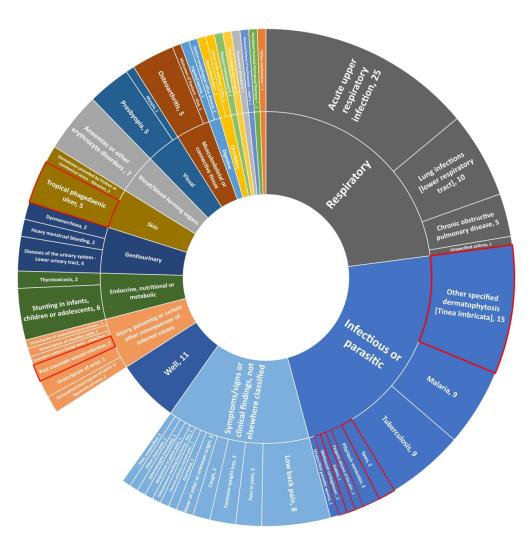


Figure 3 Clinical results of primary care assessments at Wanang. 113 Wanang villagers examined (51 females, 62 males), 168 diagnoses given (not including 11 classifications of 'well'). The proportion of each concentric circle relates to the proportion a diagnosis was given as part of the total number of diagnoses, with categories arranged clockwise high to low. The inner circle shows ICD-11 primary categories, the outer circle ICD-11 specific conditions (or ICD-11 symptoms/signs/clinical findings) with number of diagnoses given for each. Infections/parasitic conditions primarily affecting skin are outlined in red. * Developmental. † Ear/mastoid process. ‡ Factors influencing health status/contact with services. § Mental, behavioural or neurodevelopmental disorders. ¶ Sleep-wake disorders. ¶ External causes of morbidity/mortality.

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Figure 4. Phased health service introduction at Wanang. Top: Examples of training provided, (left to right) fracture management, off-road vacuum-stretcher evacuation, use of malaria RDTs. Middle: Wanang Aid Post (left) and nurse consultation (right). Bottom: Examples of disease targets for proactive integrated interventions, specifically (left to right) tropical ulcer, yaws, tinea imbricata, scabies mite and eggs. Images from Wanang, apart from *Sarcoptes scabiei* microscopy (Credit: top and bottom, JM; middle, Binatang Research Centre).

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SUPPLEMENTARY FILE

Middleton, Colthart, Dem, *et al*. Health service needs and perspectives of a rainforest conserving community in Papua New Guinea's Ramu lowlands: a combined clinical and rapid anthropological assessment with parallel treatment of urgent cases. Submitted to *BMJ Open* 2023.

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REPORTING

Reporting checklist based on 'Appraising studies in health using rapid assessment procedures' [13]

This checklist is provided in line with the following statement in our protocol: 'The article will reference this protocol noting changes in method, and include a filled-in reporting checklist based on criteria for appraising studies in health using RAP' [4]. All changes are noted in the manuscript under the subheader 'Changes from our published protocol' in the methods section. Criteria in '_' are quoted from [13].

Criteria	Page, line number
'1. Aim (Is the aim of the study clearly described?)'	5, 124–127.
'2. Subjectivity (Are the researchers' background, prior knowledge and relationship to the community, and cultural competence clearly presented and addressed?)'	Paper: 6, 157–162, 176–177; 21, 598–609. Sup. File: 3.
'3. Field research guidelines (Is there an adequate description of the field guide and the rationale and process of its development?)'	Fully detailed in published protocol, which also includes all recruitment materials, KI and FG topic guides, clinical data collection forms, pharmacy, etc.[4]. Paper: 5–6, 133–142, 154–156.
'4. Staff (Is the recruitment process and training of research assistants presented, and is it sound?) RAP studies usually use research assistants in the collection of primary data from the field. Many researchers establish specific criteria for selecting assistants and these should be communicated. Further, the training process and content should be presented.'	Detailed in published protocol. Fieldwork RAs were existing RTs and PNG nationals at in-country New Bintang Research Centre. Sup. File: 3.
'5. Data collection methods (Is the rationale for the data collection methods and types of information collected with each method clearly presented?)'	Detailed in published protocol. Paper: 6, 143–156.
'6. Selection of research sites (Is an appropriate sampling strategy for selecting the study area(s) or research site(s) described?)'	n/a – site (Wanang village) was studied as it was the community that had requested health service incorporation in their existing conservation area. See 4–5, 79–123; detailed in protocol paper.
'7. Informant selection (Is a systematic process of selecting informants used and is it adequately described?)'	Fully detailed in published protocol. Paper: 6, 145–148; 7, 190–194.
'8. Credibility (Is a strategy for assessing credibility established and presented?)'	Fully detailed in published protocol. Paper: 5, 136–137; 6, 164–165; 6–7, 175-181.
'9. Analysis (Is the analysis process adequately described and was it sound?)'	Fully detailed in published protocol. Paper: Fig 2; 6–7, 157–181; 7, 194–197. Sup. File: 3.
'10. Presentation (Are the findings and discussion clearly presented?)'	Paper: 7–19, 203–593. Table 1, Figs. 3 and 4. Sup. File: 3–9, Tables S1–S6.
'11. Ethics (Are ethical principles respected and is the process for informed consent described?)'	Detailed in published protocol (including recruitment scripts, consent forms etc.). Paper: 21, 613–621.

METHODS

Fieldwork team backgrounds

BSMS: JM is a research fellow in public health with a background in pre-hospital emergency care, including in remote areas, and training in disease ecology and qualitative methods. GC is a general practitioner and experienced expedition medic with training in tropical dermatology. Both had prior field experience in Melanesia (PNG; Solomon Islands). BRC: MJ and SS were research technicians (RTs) with degrees in forestry science who were brought up in rural PNG villages, had previously worked with the community, and had pre-existing skills in social studies. JP is a RT from Wanang, where he continues to live with his family.

Capacity building for PNG staff

RTs were trained in study procedures by JM, provided the protocol [4] and [15] for reference in the field, and gained practical experience working alongside JM and GC who were present during all fieldwork. BRC staff were also given a lecture on conservation and health integration projects worldwide, and a certificated 3-day course on remote care and medical evacuation (taught by JM). FD, ML, JP, SS, and RU were additionally brought to the UK from PNG in 2019 and 2022. There they received training from Brighton and Sussex Medical School and University of Sussex (e.g., project monitoring and evaluation, eDNA, ecological and health analysis) and were taken on institutional visits nationwide (e.g., Millennium Seed Bank, University of Southampton, University of Oxford, London School of Hygiene & Tropical Medicine, Kew) to build their network of collaborators and co-plan future PNG-led work.

Generating combined all-group rankings

We generated combined all-group rankings of health issues and priorities for health service introduction by adding together inversely weighting ranks from sex-age focus groups. For example, two groups ranked malaria highest, another second highest, and the remaining as fifth highest: (1st=5) + (1st=5) + (2nd=4) + (5th=1) = 15. This was the largest combined score, so malaria was reported as the overall highest ranked health issue.

RESULTSSupplementary Table S1. Primary care assessment participants.

		Medical History	Examined
		(n=129) (%)	(n=113) (%)
Sex	Female	54 (41.9)	51 (45.1)
	Male	75 (58.1)	62 (54.9)
Age in years	0–9	50 (38.8)	45 (39.2)
	10–19	21 (16.3)	15 (13.3)
	20–29	9 (7.0)	7 (6.2)
	30–39	18 (14.0)	16 (14.2)
	40–49	10 (7.8)	9 (8.0)
	50-59	17 (13.2)	17 (15.0)
	60–69	2 (1.6)	2 (1.8)
	70–79	2 (1.6)	2 (1.8)
	Median (range)	19y (1mo-73y)	18y (1mo-73y)

Surfaces_WanangHealthNeedsSupplementary_CA16

Supplementary Table S2. Diagnoses from clinical examinations in Wanang village

Specific clinical diagnoses are listed in descending order and categorised as per the International Classification of Diseases 11th Equipment 100 11, when the property of the p https://icd.who.int/browse11/l-m/en), followed by the relevant ICD-11 primary code when appropriate. For example, 'Yaws' is lixed as a specific condition, and as a sub-category of

'Certain infectious or parasitic diseases'. Diagnoses were recoded to ICD-11 by author JM and confirmed by author GC. Percentages are of examined males/females/all, totals are greater than n as many of those examined had multi-morbidity. In this table, preserving order of individual conditions based on their frequences only allows partial grouping by ICD-11 primary categories. However, figure 3 in the main article shows full grouping by primary categories (but not break down by sex). Five your gridler (all male) of the 113 individuals examined

were only partially examined, due to non-compliance.

Conditions, as per International Classification of Diseases 11th Revision Version		Males	Females	All
02/2022 (ICD-11) (ICD-11 code) [authors additional information]	[authors additional information]	N=62 (%)	N=51 (%)	N=113 (%)
Acute upper respiratory infection, site unspecified (CA07.0)	Diseases of the respiratory system (ICD 12)	9 (14.5)	16 (31.4)	25 (22.1)
Other specified dermatophytosis (1F28.Y) [Tinea Imbricata]	Certain infectious or parasitic diseases (ICD 01)	11 (17.8)	4 (7.8)	15 (13.3)
Well *		5* (8.1)	6* (11.8)	11* (9.7)
Lung infections (CA4Z) [lower respiratory tract] †	Diseases of the respiratory system (ICD 12)	4 (6.5)	6 (11.8)	10 (8.8)
Malaria	Certain infectious or parasitic diseases (ICD 01)	4 (6.5)	5 (9.8)	9 (8.0)
Tuberculosis, unspecified (1B1Z) ‡		4 (6.5)	5 (9.8)	9 (8.0)
Low back pain (ME84.2)	Symptoms, signs or clinical findings, not elsewhere constituted (ICD 21)	6 (9.7)	2 (3.9)	8 (7.1)
Anaemias or other erythrocyte disorders, unspecified (3A9Z) §	Diseases of the blood or blood-forming organs (ICD 🕦)	2 (3.2)	5 (9.8)	7 (6.2)
Stunting in infants, children or adolescents (5B53)	Endocrine, nutritional or metabolic diseases (ICD 05)	3 (4.8)	3 (5.9)	6 (5.3)
Tropical phagedaenic ulcer (EA40)	Diseases of the skin (ICD 14)	4 (6.5)	1 (2.0)	5 (4.4)
Osteoarthritis, unspecified (FA0Z)	Diseases of the musculoskeletal system or connective issue (ICD 15)	2 (3.2)	3 (5.9)	5 (4.4)
Chronic obstructive pulmonary disease, unspecified (CA22.Z) ¶	Diseases of the respiratory system (ICD 12)	4 (6.5)	1 (2.0)	5 (4.4)
Presbyopia (9D00.3)	Diseases of the visual system (ICD 9)	5 (8.1)		5 (4.4)
Diseases of the urinary system, unspecified (GC2Z) - Lower urinary tract (XA34X0)	Diseases of the genitourinary system (ICD 16)	3 (4.8)	1 (2.0)	4 (3.5)
Pain in joint (ME82)	Symptoms, signs or clinical findings, not elsewhere cassified (ICD 21)	2 (3.2)	1 (2.0)	3 (2.7)
Excessive weight loss (MG43.5)	iia	1 (1.6)	2 (3.9)	3 (2.7)
Cough (MD12)	r te		2 (3.9)	2 (1.8)
Fever of other or unknown origin (MG26)	tech	1 (1.6)	1 (2.0)	2 (1.8)
Pityriasis versicolor (1F2D.0)	Certain infectious or parasitic diseases (ICD 01)	1 (1.6)	1 (2.0)	2 (1.8)
Yaws (1C1D) Δ			2 (3.9)	2 (1.8)
Dysmenorrhoea (GA34.3)	Diseases of the genitourinary system (ICD 16)		2 (3.9)	2 (1.8)
Heavy menstrual bleeding (GA20.50)	ະ <u>ທ</u>		2 (3.9)	2 (1.8)
Thyrotoxicosis (5A02)	Endocrine, nutritional or metabolic diseases (ICD 05)	1 (1.6)	1 (2.0)	2 (1.8)
Dermatoses provoked by friction or mechanical stress (EH92) - Abrasion (XJ652)	Diseases of the skin (ICD 14)	1 (1.6)	1 (2.0)	2 (1.8)
Strain or sprain of wrist (NC54.6)	Injury, poisoning or certain other consequences of externa auses	2 (3.2)		2 (1.8)
Post traumatic wound infection, not elsewhere classified (NF0A.3)	(ICD 22)	2 (3.2)		2 (1.8)
Dislocation or strain or sprain of joints or ligaments of the knee (NC93) **	3ib	2 (3.2)		2 (1.8)
Strain or sprain of other or unspecified parts of knee (NC93.7)	vii o	1 (1.6)		1 (0.9)
Strain or sprain of shoulder joint (NC13.5)	Bibliograp	1 (1.6)		1 (0.9)
Laceration without foreign body of ankle or foot (ND12.0)	<u>a</u>	1 (1.6)		1 (0.9)

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Pain, unspecified (MG3Z)	Symptoms, signs or clinical findings, not elsewhere cassifed (ICD 21)	1 (1.6)		1 (0.9)
Other chest pain (MD30.1)	luc 46	1 (1.6)		1 (0.9)
Chronic primary visceral pain (MG30.00)	d in		1 (2.0)	1 (0.9)
Splenomegaly, not elsewhere classified (ME10.01) [resolved]	g f	1 (1.6)		1 (0.9)
Diarrhoea (ME05.1)	for a	1 (1.6)		1 (0.9)
Abdominal or pelvic pain (MD81)	u mct		1 (2.0)	1 (0.9)
Subcutaneous swelling, mass or lump of uncertain or unspecified nature (ME61) -	es r		1 (2.0)	1 (0.9)
Iliac region (XA0NH8)				
Scabies (1G04) §§	Certain infectious or parasitic diseases (ICD 01)	1 (1.6)		1 (0.9)
Other and unspecified infestation by parasitic worms (1F90) ††	ed and 3.	1 (1.6)		1 (0.9)
Molluscum contagiosum (1E76)	to Do	1 (1.6)		1 (0.9)
Pyogenic abscess of the skin (1B75.3)	t SW		1 (2.0)	1 (0.9)
Persistent Postural-Perceptual Dizziness (AB32.0)	Diseases of the ear or mastoid process (ICD 10)	1 (1.6)		1 (0.9)
Personal history of maltreatment (QE82) - adult (XT6S) [domestic]	Factors influencing health status or contact with health status or		1 (2.0)	1 (0.9)
Myopia (9D00.0)	Diseases of the visual system (ICD 09)	1 (1.6)		1 (0.9)
Talipes equinovarus (LB98.00)	Developmental anomalies (ICD 20)	1 (1.6)		1 (0.9)
Unspecified asthma (CA23.3)	Diseases of the respiratory system (ICD 12)	1 (1.6)		1 (0.9)
Sleep-related leg cramps (7A82)	Sleep-wake disorders (ICD 07)	1 (1.6)		1 (0.9)
Inguinal hernia (DD51) - Left (XK8G)	Diseases of the digestive system (ICD 13)	1 (1.6)		1 (0.9)
Gastro-oesophageal reflux disease (DA22)	_ 		1 (2.0)	1 (0.9)
Malunion of fracture (FB80.7) - Fracture of upper end of ulna (NC32.0)	Diseases of the musculoskeletal system or connective rissue (ICD 15)		1 (2.0)	1 (0.9)
Depressive disorders, unspecified (6A7Z)	Mental, behavioural or neurodevelopmental disorders IC ₩06)		1 (2.0)	1 (0.9)
Lower limb varicose veins, not further specified (BD74.1Z)	Diseases of the circulatory system (ICD 11)		1 (2.0)	1 (0.9)
Atrial fibrillation (BC81.3)	. 	1 (1.6)	<u> </u>	1 (0.9)
Physical maltreatment (PJ20)	External causes of morbidity or mortality (ICD 23)	1 (1.6)		1 (0.9)
Totals of diagnosed morbidities *	<u>a</u> <u>ö</u>	92	76	168
	√ ₹			

^{*&#}x27;Well' classifications (marked in green) were not included in the final calculations of total diagnoses of morbidities. The following and individual diagnoses were classified by the examining primary care clinician (GC) as "possible" or "suspected": † Lung infections [lower respiratory tract], 3 of 10; ‡ Tuberculæsis, unspecified, 8 of 9; § Anaemias or other erythrocyte disorders, unspecified, 5 of 7; | Stunting in infants, children or adolescents, 3 of 6; ¶ Chronic obstructive pulmonary lise se, unspecified, 2 of 5; ∆ Yaws, 1 of 2; ** Dislocation or strain or sprain of joints or ligaments of knee, 1 of 2; †† Other and unspecified parasitic worms, 1 of 1; §§ Scabies 1; ¶ Physical maltreatment, 1 of 1.

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Table S3. Ethnoclassification taxonomy of "Malaria" (1st in combined group rankings).

Outtees in roman are translated from Tok Pisin (dual transcripts retained) quotes in italies were spoken as written.

Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians at the time.

Names	"Malaria" (Tok Pisin	and English) (all)			·		
Who	Everyone All Focus Groups [FG] agreed: "Everyone" (♂≥40y FG) "It occurs a lot in your of the time it's old peol					Informant [KI]) ● "Most
When	• "malaria can occur a time. In the dry season season – same" (3<40	, still there are mosq					ns more, you
Cause	Animal blood "They might bite our skin in this way the skin has the same blood they take it from pigs or dogs or whatever and come back and put it into men's skin." (3<40y FG)	• /	open" (♀<40y FG) • "Not	Bushy "It all grasses ne their hous (KI)	Sv "Swa ear areas ee." breed place	are a ding	Rubbish "Tins and plastics create a breeding place for mosquitoes" (KI)
Signs and symptoms	• "skin becomes yello FG) • "fever, shivers, very weak" (3<40y FC they feel dizzy, dizzing signs." (KI) • Strong I malaria) • Cough (P 7	w, they will be ill in headache, cough, co G) • "cold sickness" ess, and they tend to head pain, very high y, confirmed malaria	ellow skin ● strong head p miting ● joint pain ● coug the afternoon and morning old skin" (♂≥40y FG) ● "th (♀≥40y FG) ● "Chill, who vomit regularlywe suspe fever, joint pain, vomiting, a) ● Head pain, high fever, a) ● Can't walk properly (I	gh • tired g. They sle ney feel co en they are ect that the , very weak weak (P 1	eep. They wi old, their hair e feeling chi ey have mala k (Parent [P	Il be shivering will be stall, high feveraria, by looked of 13y with distance of malaria)	ng" (♀<40y anding on end, r, sometimes ting at those th confirmed
Treatment	Nothing/rest • "In this community they don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) ● "A lot of the time we just stay here, and the illness goes and, like it finishes on its own" (△≥40y FG)	Pharmacy drugs Chloroquine • "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (3<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol, Chloroquine, Amoxicillin" (\$\$\text{\$\ext{\$\text{\$	Steam with medicin from the forest* • "We take grass smell guava, citrus fruits, boil theat water really hot, go the bedside, cover them up, a steam" (♀≥40y FG) • "steam - make hot water them up with a bed sheet, large pot, stir it with a stic Papaya leaves, grass leave grass smell, guava leaves, ginger, citrus fruits. Only people in the community how to use it - he knows how to use medicine from the - like tree leaves, papaya. steam them, cook all of the tree leaves up and steam the body" (♂≥40y FG)	l, hem, to and We use cover , find a ck: es, a few know to cs no, ed, we dive tend forest You hese	Hospital • "the hospital will treat" (\$\square\$ <40 y FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the hospital." (KI)	Comfor "Rock cradle them allot" (♀<40y FG)	t Private health care stal Private doctor (P 7y, confirme malaria)

^{*}Similar community plant-usage for "malaria" has been reported elsewhere in PNG. For a useful summary (though one that does not evaluate effectiveness) see: WHO. Medicinal plants of Papua New Guinea. Manila: World Health Organization Western Pacific Region 2009.

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Table S4. Ethnoclassification taxonomy of "Sotwin" (2nd in combined group rankings)

Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians.

Names	"Sotwin" (all)	"Umbang aul"	
	Tok Pisin '1.out of breath, to gasp for Symptomatic labelling Given the dual meaning as biomedical condi were likely sometimes describing experience asthma, particularly when no individual clini	(Local language) (♂<40y FG)	
	breath, to available. • "I don't know what – is it TB or		
	pant; 2. to that's hard to know If we have medical r	•	
	have medical patrol team they go to the Wanang a asthma' have TB or, just a cough''' (Key Informant [
	[20] complained of "Sotwin", diagnosed on asses		
Who	"Everybody/Everyone"	>5y, especially children	Middle-aged people
	• "Everybody/Everyone" Focus Groups [FG]: ♀<40y; ∂ ≥40y; ∂<40y)* • "asthma is covering all the living people	"especially like kids, but young one is OK maybe 5	and old-age people "middle-aged people
	in Wanang, from the kids up to the old people." (KI) •	to 16 years, then people up to	and old-age people
	"cold/cough, "sotwin", they are very widespread inside	like 30 years and above	Not many young
	Wanang not just older men or women." (KI)	most of them are affected with the coughing." (KI)	people." (KI)
When	All the		○NI)
Cause	• "It's not seasonal - any time" (♂≥40y FG) • "No, all yea Smoking Chewing Meat, fish, cooking	Sex with Others	Rubbish The sun
	• (♂≥40y Betel nut • "Eating bloody meat	women "I'm sitting	and dust (♀<40y
	FG) • "think (♂≥40y Fish, like blood so, you don't the cause is FG) dry it" (♂≥40y FG)	• "a woman down and comes and they come	"If the FG) house is
	smoking So • "you cook with fish and it	has sex with round	dirty and
	most people has the smell of fish and you	you, this will behind and	you sleep
	around this don't wash it properly and use it as a water container or	cause this use the "sotwin" to same space	with rubbish,
	them are water pot for drinking, this	occur" where you	dust, then
	smokers" can cause "sotwin". Fish	(♂≥40y FG) were	you will
	(KI) if you don't dry it properly and you cook it and someone	• "the women sitting" [unclear] your (KI)	get" (♂<40y
	eats it, it can cause "sotwin""	leg Go with	FG)
	(♀<40y FG) • "the women cook, give to you	them" (3<40y FG)	
	and you eat it" ($3 < 40$ y FG)	(0×40y FG)	
Signs and	• Heavy breathing • fast breathing • difficulty during	g physical exercise • coughing • "s	sotwin" • weakness
symptoms	 "When you walk up and down the mountain, you might cabreathing very heavily then we would know, he has "sotwin" as well when you go up a mountain you will need frequent 	". Walking long distancesyou will	see coughing a lot
	He will sit down, walk around and just rest close to [the v like, your breath will become locked and you will faint" (♂ When they walk around you will see them coughing." (KI) ●	(40y FG) • "They tend to cough pub	licly, like openly.
	cough cough, suddenly it will come like very strong		
	sotwin, described symptom as cough (55y PT, diagnosed on		
	diagnosed on assessment with URTI) • has no strength (39y (P of 11months, diagnosed on assessment with LRTI)	P1, diagnosed on assessment with I	LR11) ● Sotwin a lot
Treatment	Medicine from the forest	Pharmacy drugs No trea	tment Drink
	Banana drink Papaya leaf Vine sap	1	do people cold
	• "banana in a cup, strain it, give it to the child. You can	(51y PT, (55y treat this diagnose PT, "No. Th	s illness?] water nev just (3<40v
	heal it in the village (unlike malaria which is hard - for that	d on diagno live with	h the kus, FG)
	you should go straight to the hospital). Papaya leaf' ($9 < 40y$ FG) • "You get some sap from a vine, just sap from a vine,	assessine sea on coagn.	(KI) ● d "Sotwin"
	cut it [local name: "bamul"]" (♂<40y FG) • "it doesn't	nt with assess Said had LRTI and ment but had	
	have this kind of strong medicine from the forest. We have tried many times when "sotwin" has occurred and you take		nt (P of 2y,
	these kinds of medicines and just drink them, it will only	LRTI, diagnose COPD) assessm	ed on ent with
	help you for a short time a day and tomorrow or the day	URTI, I	LRTI; 48y
	after "sotwin" will occur again, OK some "sotwin" doesn't go on for very long, it can go away and stop, and some	1 1 (414)	gnosed on
	people if "sotwin" has already taken hold of them, they will		ent with 50y PT;
	try all kinds of medicine but it won't be enough, the	e06 46y	•
	"sotwin" will continue all the way until you become old and they die" (♂≥40y FG) • Bush rope (cut the rope and		
	drink the white sap) (39y PT diagnosed on assessment with		
	LRTI)		

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Table S5. Ethnoclassification taxonomy of Cancer (3rd in combined group rankings).

Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians.

Names	"Susu cancer"	"cancer bodi insait"		ong ol mama"
	Breast cancer (♂≥40y Focus group [FG])	Cancers inside body (♂≥40)	y FG) Cervical cancer (♀<40y, ♀≥40y FGs)
Who		We don't know		hers, older women,
	"Now a lot of us living here have cancer.			unger women"
	to the hospital in order to get medicine "you have cancer" (♂≥40y FG)	e or something the doctors.	they will say $(\rightleftharpoons \ge 40y)$	FG)
When		2014 in the communities aro	ound here" (♀<40v FG)	
Cause		eat and Fish	Smoking	Betelnut
Cause		at kind of thing you don't	"This cancer that tends	"OK chew a lot
		rly sometimes this can	to be with a cough	of betelnut
		or cancer inside, it's like,	sometimes smoke a lo	then cancer will
		fish and you take it and you	then cancer will occur"	occur"
	boil it and you eat	it" (♂≥40y FG)	(∂≥40y FG)	(∂≥40y FG)
Signs and	"We don't know ourselves we find		Cough	Patient is red
symptoms	"Now a lot of us living here have cancer ourselves, we don't know if we have can		"it tends to occur with a cough and illness	"They will look like blood" (♀≥40y FG)
	we go to the hospital in order to get medi		inside it tends to occur	0100 u (∓≥40y 1'U)
	the doctors check us or when they check		again inside" (♂≥40y	
	will say "you have cancer" so we find		FG)	
	(♂≥40y FG)			
Treatment		nly the hospital will treat" (` '	
	Hospital treatment not always success		t for referrals, hospital att	
	particularly if patients flee treatme "OK cancer if it occurs, there is no way to		's wife. She – she got the cei · two years if Wanang hav	
	this, sometimes we go to the doctor and t		get a report and then move	
	doctor is able to cure the cancer, it will		sy to get treatment. But beca	
	finish suppose we tell them about our		. herself she think that she i	
	and we go and stay in the hospital, it's lil		., so we all never know who	
	cancer can be stopped but if we are afraid		tage – stage 4, then we all s	
	the injection or something and they get the needle out and we run away, sometimes		nd go to the x-ray and they e in 50-50" so we try two ho	
	cancer will not stop and the cancer will s		nnot work as they said no m	
	on the body and after you become an old		Kundiawa General Hospit	
	man you can die from this" (♂≥40y FC	G) and she passed aw	ay. So, that's happened to l	ike my mother and his
		wife" (Key Infor	mant)	

Table S6. Ethnoclassification taxonomy of "Grile" (Tinea imbricata) (4th in combined group rankings). Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians.

• "Everyone, all ages" (\$240) FG) "lends to cocur in childran, also people like us, and maybe some older men [and] women as well, little girls too Most of the time inca occurs in babies, in younger and older men just occurs in babies, in younger and older men just open middle uged people and some children as well. Maybe from small to older people Informant [K1]) When Anytime * If deepen have seasons." (K1) * "Year to year Manily in the rain, and you don't change that was the same things, these we'e things will cause this inca and seep with the same things, which we have seasons." (K1) * "Year to year Manily in the rain, and you don't change along a long road your shirn will be swearly you sit down rest, that will cause this '(5-40) FGO * "On the same type along a long road your shirn will be swearly you sit down rest, that will cause this' (5-40) FGO * "On the same type along a long road your shirn will be swearly us to down rest, that will cause this' (5-40) FGO * "On the same type along a long road your shirn will be swearly will be same type along a long road your shirn will be swearly will be same type along a long road your shirn will be swearly will be same type along the same year clothes' (K1). Signs and symptoms • "Skin like crocodile. You might get it on your arm or leg A nam with time a will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "There's a lot the will be panful' (5-240) FGO * "The was river be down the will be panful' (5-240) FGO * "The manily b	Names	<i>"Grile"</i> (Tok Pisin: ♂≥40y, ♂<40y Focus Group			"(Local languag y, ♂<40y FG)		<i>uk"</i> "crocodi ♀<40y, ♂<4	le" (Tok Pisin 0y FGs)
maybe some older men [and] women as disease" (R.) common in Pveg and it myself and left men in the a occurs in abbies, in younger and older men just of the children here coccurs in abbies, in younger and older men just of the children here coccurs in abbies, in younger and older men just of the children here with the coccurs in a proper and older men just of the children here with the may be dependent of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper and older men just of the children here with the may be a proper of the children here with the may be a proper of the children here with the may be a proper of the children here men and the same thing it seems the may be a proper of the children here with the may be a proper of the children here with the may be a proper of the children here with the may be a proper of the children here with a many out of the may be a proper of the children here with a many out of the may be a proper of the children here with a many out of the may be a proper of the children here with a many out of the may be a proper of the prop	Who							
welf, little girls too. Most of the time times occusion habits, in youngs of the children has well middle aged people and some children as well. Maybe from small to older people" ('Key Haw 186" ('Kl) You have in the school? Haw 187" ('Z=40) FG) o "You to have in the school? Haw 280" ('Kl) FG) o "More people are hiding it so was the same things. It has well as the same things will cause this time. Show the same things will cause this time and you wash to the same things. It have time and bathe upstream and a man with time awashes something you will are carries them and he can get them, you walk in the rain and you who have different kinds of water, some won't have income the same things. It have time and bathe upstream from you, in the same things will cause this time. Show the same things. It have time and bathe upstream and a man with time awashes something you will are carries them and be can get them, you walk in the rain with the water. Journal of the same things will cause this time. Show the same things will cause this time. Show the same things will cause this will be swearly will be painful" ('Z=40) FG) o "They will be scratching." It is like all over the body, that is time and you want to the painful" (Z=40) FG) o "They will be scratching." It is like all over the body, that is time and you see it, it bears a body the well be painful" (Z=40) FG) o "They will be scratching." It is like all over the body, that is time and you see it, it bears a body the well be painful" (Z=40) FG) o "They will be scratching." It is like all over the body, that is time and you see it, it bears a body the well as a body to the wel								
cocurs in sbeits, in younger and older men just of the childrehe here occasionally "(24 by FG) o" 16 people. Important [K1]) When Maybe from small to older people is may be the state of the children as well many children do you had you for the seasons." (K1) o" "Anytime o" 17 doesn't have seasons." (K1) o" "Anytime" (22-40) FG) o" "Anytime" (22-40) FG) o" "Anytime" (22-40) FG) o" "Anytime" (22-40) FG) o" "Anytime" (22-40) FG o" "Anytime" (22-40)						common in	_	-
occasionally" (5²40) FG) • "older people". (How middle aged people and some children as well many children do you Maybe from small to older people" (Key Maybe from small to older people. (Key Maybe from small to older people.) (Key Maybe from small to o								
middle aged people and some children as well, many children do you haybe from small to older people ("Key" All have 186." ("Kl) When When Wet clothes *You bathe and keep wet clothing on you will get times very fist ("€40y FG) *"I you go an "ise at the dearst have seasons." ("Kl) *"You po walking in the rainy seasons get we in the rain, and you don't change your clothes, you keep it on, you sleep will not be same things. "He sew et things will cause this time you fee walking along a long road your shirt will be sweatly, you sid down rest, that will ease this fline, you feel walking along a long road your shirt will be sweatly will be sweatly along a long road your shirt will be sweatly will be sweatly along a long road your shirt will be sweatly will be sweatly along a long road your shirt will be sweatly will be sweatly along a long road your shirt will be sweatly will be sweatly will be paintful?" ("€240) FG) *" here is rever five washing when you walk in the rain and you don't change your clothes" ("Kl) *"Skin like crocodile. You might get it on your arm of leg A man with time awill stratch, a woman also, the skin will be paintful?" ("€240) FG) *" They will be restricting if si like all over the body, all the time and you wash to they re lething, this could be other conditions so how dow keen with "Grife Labted from this free flower It yo low and alree tree bloudly thowers, if your time and you are road to the curren we make forest medicine when chewing betchant, daka pepper chewed when chewing betchant, daka pepper will read the tree with green leaves and velong the road you see it, it bears will be gaped and tree tree bloudly from this free flower It yo low and they have your ward the when chewing betchant, it will be seeds and you can just close them within a leaf and het them in the free and when they've been heated a bit, take them out and your to the many to the pays a many and the words or when you've graded till a lot, this black blood tha								
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wet clothing on you will get time avery fast" (\$\frac{2}{\text{-}}40\) FG) \circ "if you go walking in the rainy season get wet in the rain, and you don't change your clothes, you keep it on, you sleep with the same things these wet things will cause this time, you't re walking along a long road your shirt will be sweaty you sit down rest, that will cause this time you't re walking along a long road your shirt will be sweaty you sit down rest, that will cause this 'us caused by that and then the clothes they wear During the sumpy period the fast-work of the first time? (\$\frac{2}{\text{-}}40\) FG) \circ "Thee's a tree with green leaves and yellow flowers, it's found in sandy areas around large bodies of water [local hamme." "gigwal"] say you re walking along a long the road you see it, it bears yellow fruut, unripe ones will be green you just take a strainer, it will get the seeds and you can just close them with kambang." (KI) \circ "Thee's a tree with green leaves and yellow flowers, it's found in sandy areas around large bodies of water [local hamme." "gigwal"] say you re walking along a long road beat them in the fire and when they've been heated as bit, take them out and you rub them One thing is papaya — grate it, the papaya fruit, when you've grated it a lot, this, black blood that they have, you will take them out and you rub them One thing is papaya — grate it, the papaya fruit, when you've grated it a lot, this, black blood that they have, you will take them out and you rub them One thing is papaya — grate it, the papaya fruit, when you've grated it a lot, this, black blood that they have, you will take the more than the method." when you've grated it a lot, this, black blood that they have, you will take the more than the papaya fruit, when you've grated it a lot, this, and you series the mand you rub them One thing is papaya — grate it, the papaya fruit, when you've grated it a lot, this, and you rub them One t	Cause						_	
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without tinea is bathing downstream, then these little "crocodile skin particles" the water carries them and he can get them, you have fifterent kinds of water, some won't have tinea, your crowled skin particles" the water carries them and he can get them, you have tinea, your she withings will cause this tinea, the water carries them and he can get them, you water things will cause this tinea, your she water things will cause this tinea, your she washes something upstream from you wash something you will get it (\$^2-40 V FG) \(\epsilon \) "for wash something you wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something you will get it (\$^2-40 V FG) \(\epsilon \) "the wash something upstream from you use something of you wash something a lague and you wash something wou will get it (\$^2-40 V FG) \(\epsilon \) "the wash something upstream from you use something of you wash something a lague and you wash something on the fast of you wash something upstream from you use something of you wash something wou will get it." (\$^2-40 V FG) \(\epsilon \) "the same clothes, if they have tinea in this casse, bodo to have if how and then the clothes they was tinea, you will get it if my body is not the right kind of water, some won't have the leads have the clothes they you will get it if my body is not the right kind of the the clothes they you will get it if my body is not the right kind in the the clothes they you will								
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sinceyou're walking along roadyou wand you wash something you will get it" (\$<40 FG) • "they use river for washing" ut's caused by that and then the clothes they wear								
along a long roadyour shirt will be sweaty you sit down rest, that will cause this" (♂ 40 y FG) ● "They will wear During the sunny period the fast-when you walk in the rain and you don't change your clothes" (KI)		2			1			\- ·
shirt will be sweaty you sit down rest, that will cause this" (♂<40y FG) ● "when you walk in the rain and you don't change your clothes" (KI) Signs and symptoms Signs and symptoms • "Skin like crocodile. You might get it on your arm or leg A man with tinea will scratch, a woman also, the skin like to jump into those riversthose algae give them bacteria, so they have other boys (patient histories) • "Skin like crocodile. You might get it on your arm or leg A man with tinea will scratch, a woman also, the skin like time. [Q]: So they 're itching, this could be other conditions so how do we know it's Grile? [A]: Itchy and it just go on their skin by looking at them you can see that they have go on their skin by looking at them you can see that they have Grile." (KI) Treatment Treatment Treatment Treatment Treatment Treatment **We are not able to cure we make forest blood but paste • "take kambang [lime powder used when chewing betelnut], dak [pepper chewed when chewing betelnut], and the bud from this tree flower try to mix them with kambang." (KI) • "There's a tree with green leaves and yellow flowers, it's found in sandy areas around large bodies of water [local name: "sigwal"] say you're walking along the road you see it, it bears yellow firuit, untripe ones will be green you just take a strainer, it will get the seeds and you can just close them within a leaf and he heat them in the fire and when they 've been heated a bit, take them out and you urb them One thing is papaya grate it, the papaya fruit, when you've grated it a lot, this black blood that they have, you will take this and you scratch your time and you rub it in find the place where it is the pain." (d²-40y FG) • Tile will take this and you scratch your time and you rub of use the papaya fruit, when you've grated it a lot, this black blood that they have, you will take this and you scratch your time and you rub of use the papaya fruit, when you've grated it a lot, thi								
sit down rest, that will cause this" (3<40 y FG) • The power it is one people are hiding it so you can't see it' (°£≥40 y FG) • Treatment Treatment Treatment Treatment Treatment Seeds of "Moder" blade people chewed when chewing betelnut], and the bud from this tree flower ty to mix them with kambang." (8) • The will bud from this tree flower ty to mix them with strain people, chewed when chewing betelnut], and the bud from this tree flower ty to mix them with straine nix strainer, it will get the seeds and you can just close them within a leaf and heat them in the fire and when they ve been heated a bit, take and when they ve been heated a bit, take and when helve ye been heated a bit, take and when they ve been heated a bit, take them out and you rub them One thing is papaya grate it, the papaya fruit, when you've grated it a lot, this black blood that they have, you will take this and you scratch your tinea and you rub it in find the place where it is the pain." (3²40 y FG) **We are not able to cure we make forest medicine, we buy medicines [but] it just comes back." (3²40 y FG) **Gadoy FG) • Transmitted from person with Grile transmitted from the to jump into those riversthose a forlie transmitted from person with Grile transmitted from the two what the time will scratch, a woman also, the skin with time a will transmitted from the to jump into those riversthose and the with time a will transmitted from the to jump to what the time will transmitted from the to jump the medicine will scale the fire and when the dour we make forest medicine, we buy medicines [but] it just comes back." (3²40 y FG) • The from jump t			\ - J	•	v			
cause this" (♂40 y FG) ● "when you walk in the rain and you don't change your clothes, '(d) FG) ● They will be painful'' (♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be scratching 'It's like all over the body, that's what this tinea is '(♂40 y FG) ● They will be carried in a boundary on their skin black blood the body carried in the will be painfull' (♂40 y FG) ● They will be carried in the will be painfull' (♂40 y FG) ● They will be carried in a boundary on their skin black blood that they have cooled '(♂40 y FG) ● They will be carried in the will be painfull' (♂40 y FG) ● They will be carried in the will b								
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Signs and symptoms • "Skin like crocodile. You might get it on your arm or leg A man with tinea will scratch, a woman also, the skin will be painful" (♂≥40 y FG) • "They will be scratching it's like all over the body, that's what this tinea is" (♂≥40 y FG) • "Itchy all the time and they tend to scratch it all the time. [Q]: So they're itching, this could be other conditions so how do we know it's Grile? [A]: Itchy and it just go on their skin by looking at them you can see that they have Grile." (KI) Treatment Treatm		"when you walk in the rain	se riversthose	(♂<40y I	G) • transmi	itted from		
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will be painful" (♂≥40y FG) • "They will be scratching it's like all over the body, that's what this tinca is" (♂≥40y FG) • Some people are hiding it so you can't see it" (②≥40y FG) • "trchy all the time and they tend to scratch it all the time [Q]: So they're itching, this could be other conditions so how do we know it's Grile? [A]: Itchy and it just go on their skin by looking at them you can see that they have Grile." (KI) Treatment Treatment Treatment Treatment Treatment Treatment Treatment Plant-based ointments from the forest Lime, Seeds of "Moder" houghpeper, "sigwal" [Papaya and tree tree blood] when chewing betelnut], and the bud paste • "take kambang [lime powder used when chewing betelnut], and the bud from this tree flower try to mix them with kambang." (KI) • "There's a tree with green leaves and yellow flowers, it's found in sandy areas around large bodies of water [local name: "sigwal"] say you're walking along the road you see it, it bears yellow fruit, unripe ones will be green you just take a strainer, it will get the seeds and you can just close them within a leaf and heat them in the fire and when they've been heated a bit, take them out and you rub it in find the place where it is the pain." (♂ <40y FG) • Grile tablet when you've grated it a lot, this black blood that they have, out will take this and you scratch it all the time and they then they treat the skin inside bud from the propagal them of the variance of the people in the skin inside bud from people, take a knife to we houghly them (So don't use this when they've been heated a bit, take them out and you rub them One then they wave or caracted the them the body, all the medicine, of the thin this tree looks a difference of the word on the delice of the word on the de	-	- 401 ' 1'1 1'1 V					,	4 1:
FG) ● Some people are hiding it so you can't see it' (⊋≥40y FG) ● "Itchy all the time and they tend to scratch it all the time. [Q]: So they're itching, this could be other conditions so how do we know it's Grile? [A]: Itchy and it just comes back." (♂<40y FG) ■ Traditional treatments Plant-based ointments from the forest Lime, Seeds of "Moder" peoper, "sigwal" [Papaya and tree tree blood] bud paste ● "take kambang [lime powder used when chewing betelnut], daka [peoper chewed when chewing betelnut], and the bud from this tree flower try to mix them with kambang." (K1) ● "There's a hole in a tree with green leaves and yellow flowers, it's found in sandy areas around large bodies of water [local name: "sigwal"] say you "re walking along the road you see it, it bears yellow fruit, unripe ones will be green you just take a strainer, it will get the seeds and you can just close them within a leaf and heat them in the fire and when they've been heated a bit, take them out and you rub them One thing is papaya – grate it, the papaya fruit, when you've grated it a lot, this black blood that they have, you will take this and you scratch your tinea and you rub it im find the place where it is the pain." (♂<40y FG) ■ Grile tablet (From pharmacy) **No Treatment* **Grile eream** **Hospital/Pharmacy** **Hospital/Pharmacy** **Grile tablet**	symptoms							
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(\$\delta<40y FG) (patient histories)		and you scratch your tinea an it in find the place where it	d you rub is the	of us don't use this		soap th	ere" (KI) tablet	

Reporting checklist based on 'Appraising studies in health using rapid assessment procedures' [13]

This checklist is provided in line with the following statement in our protocol: 'The article will reference this protocol noting changes in method, and include a filled-in reporting checklist based on criteria for appraising studies in health using RAP' [4]. All changes are noted in the manuscript under the subheader 'Changes from our published protocol' in the methods section. Criteria in '_' are quoted from [13].

Criteria	Page, line number
'1. Aim (Is the aim of the study clearly described?)'	5, 124–127.
'2. Subjectivity (Are the researchers' background, prior knowledge and relationship to the community, and cultural competence clearly presented and addressed?)'	Paper: 6, 157–162, 176–177; 21, 598–609. Sup. File: 3.
'3. Field research guidelines (Is there an adequate description of the field guide and the rationale and process of its development?)'	Fully detailed in published protocol, which also includes all recruitment materials, KI and FG topic guides, clinical data collection forms, pharmacy, etc.[4]. Paper: 5–6, 133–142, 154–156.
'4. Staff (Is the recruitment process and training of research assistants presented, and is it sound?) RAP studies usually use research assistants in the collection of primary data from the field. Many researchers establish specific criteria for selecting assistants and these should be communicated. Further, the training process and content should be presented.'	Detailed in published protocol. Fieldwork RAs were existing RTs and PNG nationals at in-country New Bintang Research Centre. Sup. File: 3.
'5. Data collection methods (Is the rationale for the data collection methods and types of information collected with each method clearly presented?)'	Detailed in published protocol. Paper: 6, 143–156.
'6. Selection of research sites (Is an appropriate sampling strategy for selecting the study area(s) or research site(s) described?)'	n/a – site (Wanang village) was studied as it was the community that had requested health service incorporation in their existing conservation area. See 4–5, 79–123; detailed in protocol paper.
'7. Informant selection (Is a systematic process of selecting informants used and is it adequately described?)'	Fully detailed in published protocol. Paper: 6, 145–148; 7, 190–194.
'8. Credibility (Is a strategy for assessing credibility established and presented?)'	Fully detailed in published protocol. Paper: 5, 136–137; 6, 164–165; 6–7, 175-181.
'9. Analysis (Is the analysis process adequately described and was it sound?)'	Fully detailed in published protocol. Paper: Fig 2; 6–7, 157–181; 7, 194–197. Sup. File: 3.
'10. Presentation (Are the findings and discussion clearly presented?)'	Paper: 7–19, 203–593. Table 1, Figs. 3 and 4. Sup. File: 3–9, Tables S1–S6.
'11. Ethics (Are ethical principles respected and is the process for informed consent described?)'	Detailed in published protocol (including recruitment scripts, consent forms etc.). Paper: 21, 613–621.

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page & line
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 1–4; 2, 35–36
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2, 37–53
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4–5, 69–130. Additionally, extensive wider background and discussion of methodological rationale given in
			published protocol paper, relevant section sign posted in start of this paper (4; 76–78: 'Here we outline site-specific context, biodiversity and health issues in PNG and our methodological rationale are discussed in detai in our published protocol.[4]')
Objectives	3	State specific objectives, including any prespecified hypotheses	2, 33–34; 5, 124–130.
Methods			
Study design	4	Present key elements of study design early in the paper	4, 72–76; 5–6, 132–142; Figure 2 methodological flowchart.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Description of setting and location: 4–5, 79–123. Periods of recruitment and data collection 5, 134; 6, 143–145. Exposure and follow-up n/a.
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Described extensively in published protocol paper. In manuscript: 6, 145–148; 7, 190–194. Follow up n/a.
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a, not a matched study.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6, 152–156, 163–173. Detailed in published protocol paper, and its supplementary file.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 143–156; Detailed in published protocol paper, and its supplementary file. Study consisted of one community, with assessment methods uniform across group.
Bias	9	Describe any efforts to address	7, 180–181.

		potential sources of bias	Surfaces_WanangHealthNeedsSTROBE_
Study size	10	Explain how the study size was	Paper: 6, 145–148; 7, 190–191.
Study Size	10	arrived at	1 , , , ,
		arrived at	Protocol paper, Table 1'Study cohort and justification of participant numbers and
Quantitative variables	11	Explain how quantitative variables	composition'. Paper: 6, 162–164; 7, 194–197; table 2.
Qualititative variables	11	were handled in the analyses. If	Paper's Supplementary File: 3, 'Generating
		·	
		applicable, describe which	combined all-group rankings'
Ct-t'-t'-1tl - 1-	10	groupings were chosen and why	0.1.1
Statistical methods	12	(a) Describe all statistical methods,	Only basic descriptive statistics reported: 6–7,
		including those used to control for	162–164; Paper's Supplementary File: 3,
		confounding	'Generating combined all-group rankings'.
			(Note: See other attached reporting checklist re
			RAP studies, which covers wider methods
			used).
		(b) Describe any methods used to	6, 167–169
		examine subgroups and interactions	
		(c) Explain how missing data were	8, 214–215
		addressed	
		(d) If applicable, explain how loss to	n/a
		follow-up was addressed	
		(e) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at	7, 204–211; Figure 2.
		each stage of study—eg numbers	
		potentially eligible, examined for	
		eligibility, confirmed eligible,	
		included in the study, completing	
		follow-up, and analysed	7
		(b) Give reasons for non-	6, 146–147; 7, 191–194.
		participation at each stage	
		(c) Consider use of a flow diagram	Figure 2
Descriptive data	14*	(a) Give characteristics of study	4, 79–93; 7, 205–211; Figure 2
		participants (eg demographic,	Paper's supplementary file, Table S1
		clinical, social) and information on	
		exposures and potential confounders	
		(b) Indicate number of participants	8, 214–215; paper's supplementary File, Table
		with missing data for each variable	S2.
		of interest	
		(c) Summarise follow-up time (eg,	n/a
		average and total amount)	
Outcome data	15*	Report numbers of outcome events	n/a
		or summary measures over time	
Main results	16	(a) Give unadjusted estimates and, if	Our main results are not of this type as our
		applicable, confounder-adjusted	study is a combined clinical and rapid
		estimates and their precision (eg,	anthropological assessment. Main results are
		95% confidence interval). Make	reported: 8–14, 216–444; Table 1; Figure 3;
		clear which confounders were	Supplementary file, Table S2–S6.
		crear winer comounders were	Supplementary file, Table 52-50.

			Surfaces_WanangHealthNeedsSTROBE_3
		adjusted for and why they were	
		included	See other attached reporting checklist re RAP
			studies for more details.
		(b) Report category boundaries	n/a
		when continuous variables were	
		categorized	
		(c) If relevant, consider translating	n/a
		estimates of relative risk into	
		absolute risk for a meaningful time	
		period	
Other analyses	17	Report other analyses done—eg	See answer to 16a above.
		analyses of subgroups and	
		interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with	15, 446–467.
		reference to study objectives	
Limitations	19	Discuss limitations of the study,	3, 57-68; 15, 468-490; discussed in detail in
		taking into account sources of	our published protocol paper, with signposting
		potential bias or imprecision.	in this manuscript 16, 478-480
		Discuss both direction and	
		magnitude of any potential bias	
Interpretation	20	Give a cautious overall	16–18, 491–577
		interpretation of results considering	
		objectives, limitations, multiplicity	
		of analyses, results from similar	
		studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external	16, 491–508
		validity) of the study results	
Other information			7
Funding	22	Give the source of funding and the	22, 639–644
		role of the funders for the present	
		study and, if applicable, for the	
		original study on which the present	

^{*}Give information separately for exposed and unexposed groups.

article is based

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

Health service needs and perspectives of a rainforest conserving community in Papua New Guinea's Ramu lowlands: a combined clinical and rapid anthropological assessment with parallel treatment of urgent cases

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- 1 Health service needs and perspectives of a rainforest
- 2 conserving community in Papua New Guinea's Ramu
- 3 lowlands: a combined clinical and rapid anthropological
- 4 assessment with parallel treatment of urgent cases
- 5 Jo Middleton^{1*}, Gavin Colthart¹, Francesca Dem², Alice Elkins³, James Fairhead⁴, Richard J Hazell³,
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- **Keywords:** Primary care; Tropical medicine anthropology, epidemiology; Qualitative research;
- 29 Health services administration and management; Neglected diseases.

ABSTRACT

- *Objectives:* Determine community needs and perspectives as part of planning health service
- incorporation into Wanang Conservation Area, in support of locally driven sustainable development.
- *Design:* Clinical and rapid anthropological assessment (individual primary care assessments, Key
- 35 Informant [KI] interviews, Focus Groups [FGs], ethnography) with treatment of urgent cases.
- 36 Setting: Wanang (pop. c189), a rainforest community in Madang province, Papua New Guinea.
- *Participants:* 129 villagers provided medical histories (54 females (f), 75 males (m); median 19y,
- range 1mo-73y), 113 had clinical assessments (51f, 62m; median 18y, range 1mo-73y). $26 \ge 18y$
- participated in sex-age stratified FGs (f<40y; m<40y; f≥40y; m≥40y). Five KIs were interviewed (1f,
- 40 4m). Daily ethnographic fieldnotes were recorded.
- **Results:** Of 113 examined, 11 were 'well' (a clinical impression based on declarations of no current
- 42 illness, medical histories, conversation, no observed disease signs), 62 (30f, 32m) were treated
- 43 urgently, 31 referred (15f, 16m), indicating considerable unmet need. FGs top-4 ranked health issues
- concorded with KI views, medical histories, and clinical examinations. For example,
- ethnoclassifications of three ([a] "malaria", [b] "sotwin", [c] "grile") translated to the five biomedical
- 46 conditions diagnosed most ([a] malaria, 9 villagers; [b] upper respiratory infection, 25; lower
- 47 respiratory infection, 10; tuberculosis, 9; [c] tinea imbricata, 15), and were highly represented in
- declared medical histories ([a] 75 participants, [b] 23, [c] 35). However, 29.2% of diagnoses (49/168)
- 49 were limited to one or two people. Treatment approaches included plant-medicines, stored
- 50 pharmaceuticals, occasionally rituals. Travel to hospital/pharmacy was sometimes undertaken for
- severe/refractory disease. Service barriers included: no health patrols/accessible aid post; remote
- hospital; unfamiliarity with institutions; medicine costs. Service introduction priorities were: aid post;
- vaccinations; transport; perinatal/birth care; family planning.
- 54 Conclusions: This study enabled service planning and demonstrated need sufficient to acquire
- 55 funding to establish primary care. In doing so, it aided Wanang's community to develop sustainably,
- without sacrificing their forest home.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This research was a response to a community request rather than external disease priorities, thus better supporting community determined service planning.
- The methodology enabled rapid assessment of Wanang's health issues within cost-effective time frames.
- The mixed-method approach provided increased confidence in findings by triangulation of qualitative and quantitative data.
- Treating urgent cases was an immediate benefit to partner communities in advance of full provision of health services.
- Rapid assessments can overlook nuances which may be picked up by more prolonged ethnographic methodologies, and the breadth of health issues assessed reduced capacity to report specific health burdens as accurately as single-disease focused research.

INTRODUCTION

 Papua New Guinea's (PNG) health-related UN Sustainable Development Goal indicators are worse than all but two nations outside Africa,[1] and its rainforests are threatened by commercial logging driven primarily by global commodity demands.[2, 3] We report a health needs assessment carried out as our first step to simultaneously act on both these crises, by supporting a medically neglected community who are conserving their forest. Here we outline site-specific context, biodiversity and health issues in PNG and our methodological rationale are discussed in detail in our published protocol.[4]

Medicine and remoteness in PNG

If you were to find yourself in the provincial town of Madang on New Guinea's north coast and had access to a 4x4 vehicle that could traverse seasonal logging roads, you could start to make your way to the village of Wanang. After 3–4 hours of driving into the forested interior, the increasingly deteriorating roads (figure 1) abruptly end. A waist-deep river crossing and a few hours of trekking later and you would arrive in a distributed settlement of c.189 people, surrounded by food gardens and 15,000ha of conserved rainforest (map, figure 1). For two decades scientists from PNG and as far away as the Czech Republic and the USA have made this journey to conduct ecological research with the people of Wanang. For the first author, and probably others, this journey is experienced as an exciting adventure into a remote interior. Yet, this is an outsider perspective, likely shaped in part by colonial-era established cultural tropes around 'expeditions'.[5, 6] In contrast, for Wanang villagers (such as co-authors JP and RU), the 80km journey in-reverse to Madang, is that needed to access the nearest hospital or pharmacy. Given the absence of primary care services in the community, from this perspective it is not their community that has been 'remote', but rather modern medicine.

Difficulties in accessing health services are common for c87% of PNG's c9 million population who live in rural communities.[7] PNG has one national referral hospital and 36 provincial and district hospitals, largely sited in towns. Reaching these facilities is expensive and difficult for most rural residents, even when healthy. Official rural primary care is provided at c3000 health centres and aid posts,[7] staffed by health-extension officers and nurses, and operated by government, churches, NGOs, or commercial interests such as mines.[8] These offer basic diagnoses, medical supply, and trauma treatment, and refer on to specialist services. However, even these can take days to walk to over rough terrain. This was the case at Wanang in 2016 when ecologists from New Guinea Binatang Research Centre (https://www.ngbinatang.com/) and community members (including leaders of all Wanang's nine clans) met to discuss the future of a long-standing conservation collaboration. This had been formed in 2001 when the logging frontier reached Wanang, and clans refused corporate inducements and pressure, declaring most of their forest home as the Wanang Conservation Area.[3] To make their initiative viable in the long-term they reached out to ecological researchers to access

development benefits. These have included research training and employment, a school,
 transportation, and income.[3] The meeting in 2016 identified healthcare as 'the main missing service'
 [9] to be developed in the collaboration's next phase.

In more industrialised countries, clinical interactions are commonly recorded electronically in routinely collected patient data.[10] In contrast, in rural PNG aid post workers have traditionally recorded total consultations and broadly what they were for *on a single-sheet yearly form*, but generally do not keep patient data. Instead, individuals have been encouraged to obtain pamphlet-style health books which they keep at home (figure 1), in which information is entered for reference the next time treatment is sought. In principle this has been sensible given available resources. However, health books are often scarce, and can deteriorate quickly in wet, humid rainforest environments. Additionally, some hospitals require individuals have health books to receive treatment (effectively making them care passports), so they are often surreptitiously shared and thus include records of multiple individuals as though they are one person, making them inaccurate sources of medical history.[11] During the design of this health needs assessment [12] community members reported that few people had health books. With no aid post, summary information on burdens was unavailable. This then was the clinical situation at Wanang: remote secondary care; no primary care services in the community; sparse, unreliable, and dispersed patient data.

Aims

- We aimed to plan health service incorporation into the conservation collaboration, to support a locally driven sustainable development pathway. Seeking to describe disease burden and determine service priorities, our research question was: What are Wanang's health needs?
- To understand community perspectives and the context for interventions, we also had two subsidiary questions: (1) How do people in Wanang classify diseases, their symptoms, and causes? (2) How are these treated, and by whom?

METHODS

Study design and procedures

We carried out a clinical and rapid anthropological assessment with parallel treatment of urgent cases, in Wanang between 17–25 July 2018. It consisted of Key Informant (KI) interviews, Focus Groups (FGs), individual clinical assessments by a general practitioner (with treatment and referral where necessary), and ethnography (methodological flowchart, figure 2). This enabled rapid collection of qualitative and quantitative data (at individual and community levels), and subsequent triangulation. It also provided immediate clinical benefits. Our methods are detailed in our published protocol;[4] here we give an outline and describe changes. A reporting checklist following 'Appraising studies in health using rapid assessment procedures'[13] is in supplementary file (p.2). JM designed the protocol in

discussion with its co-authors, [4] after consideration of participatory planning case studies archived at the Participation Resource Centre.[14] Data was collected by a team from Brighton and Sussex Medical School in the UK (co-authors JM and GC) and Binatang Research Centre in PNG (co-authors MJ, JP, and SS) (backgrounds and capacity building, supplementary file, p.3). All residents of Wanang were eligible and invited for clinical assessments, those ≥18y for FGs. Recruitment for both was self-selecting, by attending the temporary research shelter after a village meeting. KIs ≥18y were purposively selected based on Research Technician (RT) knowledge. Informed consent is described in the ethics statement. Digitally recorded FGs were held separately by sex-age (females [f]<40y, males [m]<40y, f>40y, m>40y) in Tok Pisin (PNGs national creole). Similarly, interviews and clinical assessments, unless participants preferred English. Recordings were transcribed verbatim in Tok Pisin, then translated into English.

The tok ples (meaning local language in Tok Pisin) of Wanang is Magi, which is unique to the Wanang area.[15] Part of the Aisian language group of the Trans-New Guinea family, Magi is largely mutually intelligible with neighbouring Aisi,[15] which is also the mother tongue of some Wanang villagers. In addition, a handful of Kalam people from Simbai settled in the community over a decade previously and speak Etp (also Trans-New Guinean[16]). Our assumption when designing the study was that most potential participants would understand either spoken Tok Pisin or English, and we planned that RTs would arrange translation by key informants for those who only spoke a tok ples (presumed to be a small minority).[4] Primary care assessments were conducted simultaneously with FGs, and involved taking medical history, clinical interview and examinations, using basic diagnostic equipment and malaria Rapid Diagnostic Tests (RDTs) when deemed necessary. Team members wrote daily ethnographic fieldnotes. Our protocol's supplementary file[17] includes: focus group and key informant interview topic guides; participant information sheets and consent forms; our primary care assessment questionnaire and data collection form; treatment formulary and equipment; safety measures.

JM conducted analysis informed by multidisciplinary reflection from fellow co-investigators and collaborators: specifically, from anthropology (JF and HM), ecology (FD, VN, MP, AJS), global health (MGH), mycology (JI), PNG health research (ML, WP), primary care (GC), epidemiology (JAC), statistics (CIJ), philosophy of medicine (JAS), and dermatology (SLW). The eight co-authors who are PNG nationals (FD, MJ, ML, JP, JP, WP, SS, RU) contributed, in addition to disciplinary knowledge, essential contextual understanding. Quantitative data were entered into Microsoft Excel, and descriptive statistics generated on participation, medical histories, diagnoses, treatments, and referrals. Qualitative data from FG and KI transcripts (primarily in national language Tok Pisin with side-by-side English translations), alongside medical history from patient assessments, and research staff fieldnotes were imported into NVivo 1.6.1 (QSR International, Melbourne) and analysed to produce three outputs. Firstly, sex-age FG rankings of health issues affecting the community and

service priorities (collected using nominal group technique[18]) were tabulated, compared, and contextualized with explanations from the wider data. Secondly, disease ethnoclassification taxonomies were created by coding data to pre-chosen higher order themes (e.g., perceived causes, symptoms, appropriate treatments) as per Scrimshaw & Hurtado.[19] Thirdly, a narrative description of community perspectives on service provision was produced by coding to main themes in our topic guides, with additional themes added as they emerged during repeated readings. In all cases, framework analysis[20] was conducted with matrixes generated in NVivo to enable ordering of themes and comparative analysis. To increase credibility: qualitative and quantitative data were triangulated; available KIs were given transcripts to check; co-author RTs with prior experience of the community, including two from Wanang, commented on interpretations; disease names/descriptions identified by FGs are given in Tok Pisin as well as English to demonstrate valid translation (table 1); supporting quotes are provided in the main text and in ethnoclassification taxonomies. To reduce bias, the diagnosing clinician (GC) was not involved in FGs or KI interviews, and was not told their results until after all diagnoses were given.

Findings were disseminated to the Madang Provincial Health Authority, and to the UK Darwin Initiative (https://www.darwininitiative.org.uk/) as part of a successful application to fund health service introduction into the Wanang Conservation Area. JM authored the resultant health service plan (box 1) in consultation with other Co-Is with health service backgrounds (GC, JAC, ML, SLW). A verbal summary was provided at a village meeting, and this manuscript (with Tok Pisin plain language summary) given to the community's health committee (formed as a result of this assessment).

Changes from our published protocol

On RT advice we additionally interviewed two teachers from the school in Wanang, whose students attend from communities in the surrounding area. We adhered to our protocol's triage for clinical assessments, but additionally issued numbered queue tickets so those 'perceived (by themselves or their parent) to not have an illness'[4] could estimate when their examination would likely take place, so they had the option of leaving and returning. To support comparison with data collected elsewhere JM recoded diagnoses (verified by GC) to International Classification of Diseases 11 (ICD-11).[21] In addition to sex-age FG rankings of health issues and service priorities, we generated all-group rankings by adding inversely weighting ranks (supplementary file, p.3).

COVID-19

COVID-19 did not affect data collection or most analysis as they were conducted prior to the pandemic, as was our subsequent obtaining of funding for health service introduction (outlined in the discussion section of this paper). However, secondment of multiple co-authors to national level public health responses delayed writing up for journal publication. In addition, inter- and intra- national

travel restrictions delayed further community health assessments with conservation communities elsewhere in PNG (specifically on Mount Wilhelm [4]).

Patient and public involvement

The study determined clinical and community priorities as part of co-planning services following community request for healthcare. PNG staff from the province were involved in design, including co-author JP from Wanang. Community members advised on research conduct and burden, aided recruitment, and co-authored this paper.

RESULTS

Participants

Individual consents for clinical assessments were provided for 135 people. Of these, medical history was obtained for 129 (54f, 75m; median 19y, range 1mo-73y) and 113 examined (51f, 62m; median 18y, range 1mo-73y) (table S1, supplementary file, p.3). Data from all were used in analysis. In our protocol[4] we reported a survey recording 189 individuals (89f, 100m). KIS did not consider there had been major population changes in the intervening two years. Based on this, medical history and examination data would represent 68.3% and 59.8% coverage respectively. Twenty-six ≥18y took part in FGs (sex and age, figure 2), five KIs were interviewed (sex and backgrounds, figure 2). Our linguistic expectations were borne out during data collection. Most participants understood and spoke Tok Pisin, a small number preferred to talk with us in English, and translation support for local languages was only required for a few villagers (mostly from older age groups). Quotes in roman typeface are translated from Tok Pisin (dual transcripts retained), those in italics are written as spoken. Attributed texts without quotation marks are from patient histories summarised by RTs at the time. Some subjects in the topic guides were not addressed by some FGs and KIs, but for all reported quantitative variables of interest (such as diagnoses, table S2, supplementary file, p.4) there were no participants with missing data.

Disease burdens

- Key informants and focus groups
- All KIs said "malaria" significantly affects their community. Other leading burdens identified were shortness of breath ("sotwin"), tinea imbricata (a superficial fungal infection), cough, and tropical ulcers ("most people in Wanang, they've ulcer on their legs, arms" [KI]). FGs identified 31 health issues affecting their community, ranking top-5's (table 1). These included ethnoclassifications (1) largely imported from biomedical English (e.g., "TB"), (2) trackable to specific biomedical conditions (e.g., "pukpuk" meaning 'crocodile', a reference to body-wide skin scaling pathognomonic of tinea
- imbricata), and (3) naming signs/symptoms with unspecified aetiology (e.g., "pispis blut", blood in

by "sotwin" (three FGs), cancer (two FGs), and "grile" (i.e., tinea imbricata) (two FGs). Each FG ranked at least one top-5 issue which was not selected by the others. The greatest discordance was between f≥40y and everyone else. They identified "malaria" as a top-5 issue, but ranked it fifth. None of their other top-5s were similarly ranked by others or, except one, listed. They ranked two pregnancy related conditions as top-5s, no others listed any (f<40y and m≥40y identified related service need later in FG discussions). Cancer ranking third was surprising given the community age structure. One male FG participant went as far to say: "now a lot of us here are living with cancer". Interviews indicated concerns partly arose from a recent unexpected death of an influential woman:

"think she is OK but the sickness is inside... we all surprised when we took her to hospital, and go to the x-ray and they said "oh, cancer" (KI).

Tinea imbricata was not identified by f≥40y or <40y as a community health problem, but m≥40y and <40y ranked it a top-5. The latter said it: "tends to occur in children, and also in people like us... older men and older women it just occurs occasionally". The female RT (co-author MJ) recorded the same impression in her fieldnotes based on living in the community. All field staff observed skin ulcers were common in children. Similarly, when watching children in daily life it seemed to MJ many had prolonged coughs, as did older men and women. Three of the team noted smoking tobacco wrapped in newspaper seemed very common amongst adults.

Table 1. Health issues affecting the Wanang community and priorities for service introduction, as identified and ranked by sex-age based focus groups

Ranked lists were produced using the nominal group technique [18], combined group ranks by reverse weighting (scores in brackets, method, supplementary file, p.3). Italic text is untranslated direct speech, Tok Pisin names/descriptions are given at first use left to right (transcripts retained). Ethnoclassifications of the top four ranked health issues ("Malaria", "Sotwin", Cancer, "Grille") are summarised in the main text, and detailed with quotes in tables S3–6 (supplementary file, p.6–9).

Females <40y	Males <40y	Females ≥40y	Males ≥40y	Combined ranking
Top five health issues, as ran	ked by sex-age focus gr	оир		
"Malaria"	"Sotwin"	Lower body painful/stiff*	"Malaria"	"Malaria" (15)
"Sotwin"	"Malaria"	Pregnancy anaemia †	Cancer ‡	"Sotwin" (12)
Lower abdominal pain §	"Grile"	Fish-eye sore	"Sotwin"	Cancer (6)
Cancer ‡	Fever "Skin hot"	Retained placenta ¶	"TB"	"Grile" (4)
Headache "Het pen"	Cough/cold "Kus"	"Malaria"	"Grile"	
Health issues identified by al.	l sex-age focus group, b	ut not included in their individua	ul ton fives	
(in top five)	(in top five)	"Sotwin"	(in top five)	
Cough/cold	(in top five)	Cough/co	old	
(in top five)		Headache		
Health issues identified by on	nly three sex-age focus g	roups		
Skin p				
Back pain "Back	ksait pen"		Back pain	
Diarrhoea "Pek	pek wara"		Diarrhoea	
(in top five)		Cancer ‡	(in top five)	
Knee pain "Kneepen"		(in top five)	Knee pain	
Stomach-ache "Bel pen"		Stomach-a		
Toothache "Tit pen"		Toothach		
Earache "Ia pen"	T 6:: "	Earache		
	Loss of vision "a	i bilong mipela olsem i no save l Sores "Sua"	ukluk gut" (f≥40y)	
		Sores Sua		
Health issue identified by onl	ly two sex-age focus gro	ups		
	Scabies "Kaskas"		Scabies	
Health issues identified by on	ılv one sex-age focus gr	านท		
Blood in urine "Pispisblut"	.,			
Liver/heart pain "Lewapen"				
, ,	Animal bites Δ			
	Cold sickness ◊			
		Bone sickness "Bun sik"		
		Faint during period **		
			Blocked urine ††	
			Swollen stomach ‡‡	

(b)	(b) Priorities for service introduction, identified and ranked by sex-age based focus groups				
_	Females <40y	Males <40y	Females ≥40y	Males ≥40y	Combined rankings
1	"Transport"		"Aid Post"		"Aid Post" (15)
2	Vaccinations "Bebi sut" *	Road "Rot"	Vaccinations	"Family planning"	Vaccinations (11)
3	"Family Planning"	"Transport"	Perinatal & birth care	Vaccinations	"Transport" (10)
4	Perinatal & birth care †	"Awareness"	Transport ‡	"Awareness" §	Perinatal/birth (7)
5	Fracture treatment I			Perinatal & birth care	"Family planning"(7)

(a) * "When we work a lot, our legs tend to get stiff", "Taim mipela wok lot, em lek bilong mipela save tait nambaut". † "In pregnant women, stiff arms and anaemia", "Mama gat bel, na han tait na skin yellow". ‡ f<40y, cervical cancer, "sik bilong Mama"; f≥40y, breast cancer, "Susu cancer"; m≥40y, "breast cancer or cancers inside the body", "susu cancer o cancer bodi insait". § "As bilong bel pain". ¶ "Ai bilong pis". ¶ "Withold bilum bilong pikinini". # "binatang eat the teeth", "binatang kaikai tit". In tok pisin binatang refers to insects and all small living things (apart from mammals) including those invisible, such as bacteria. ∆ "Animol sa kaikai". ◊ "Kol sik". ** "During periods your eye can spin... and you will faint, in this case", "Taim i westim blut ai bilong yu i ken raum... nau olsem ap indai, long dispela". †† "Pispis blok". ‡ "Bel solap sik".(b) * For infants and children. † f<40y, "When women are pregnant, make it easier for them so they don't to travel", "Taim ol mama i gat bel, ol bai no inap go longwe bai isi long karim"; m≥40y, "Helping mothers to give birth", "Helpim ol mama long karim bebi". ‡ "If older women and older men are ill, it's difficult to carry wood to the hospital.", "Ol mama papa sik, had bilong karim ol diwai kam long haus sik". § "awareness about like HIV and AIDS, one example is HIV and AIDS, and tuberculosis, all those − health education". |
"broken necks, arms and bones − to have some way to treat", "nek bruk o han bruk, bun bruk − em bai i gat olsem bai stretim".

Medical histories, clinical assessment, and urgent treatments
Seventy-five participants (40m, 35f; 58.1%, n=129) were reported to have ever had "malaria"; 23
(6f, 17m; 17.8%) "sotwin"; two (1f, 1m; 1.6%) cancer. Thirty-five (12f, 23m; 27.1%) had had
"grile", with other infectious skin conditions also highly represented: skin ulcers, 16 (6f, 10m;
12.4%); scabies, 11 (4f, 7m; 8.5%). No f<18y reported having children or problems during
pregnancy/birth. Of 30 f≥18y, 27 had given birth to live children: 128 in total (mean 4.7 per female
with a child, range 1-14), of which 15 (11.7%) had since died. Nine (33.3%) had experienced
problems during pregnancy/birth. Summary clinical results are illustrated in figure 3 and listed
(disaggregated by sex) against ICD-11 primary and specific codes in supplementary file (table S2,
p.4). Primary categories with the highest diagnoses were 'certain infectious or parasitic diseases' and
'diseases of the respiratory system' (each respectively with 41 diagnoses, 24.4% of the total 168),
followed by 'symptoms, signs or clinical findings, not elsewhere classified' (25, 14.9%). The next
largest grouping was 'well', an evaluation given to just 11 of 113 examined (9.7%). This was a
clinical impression based primarily on self/parent declarations of no current illness, but also appraisal
of medical histories, conversation with the persons, and not observing signs of disease. The five most
common diagnosed specific conditions were acute upper respiratory infection (URI)' (25, 22.1% of
those examined), tinea imbricata (15, 13.3%), lower respiratory tract infection (LRTI) (10, 8.8%),
malaria (9, 8.0%), and confirmed or suspected tuberculosis (9, 8.0%). GC noted a wide spectrum of
malaria severity, and <i>Plasmodium falciparum</i> and <i>vivax</i> were both present (mixed in some cases). A
greater proportion of females had URI (16, 31.4%) than males (9, 14.5%), in contrast to tinea
imbricata (11m, 17.7%; 4f, 7.8%) (supplementary table S2). Many diagnoses were only made in one
or two individuals (29.2% of total illness diagnoses, 49 of 168). Sixty-two villagers received urgent
treatments (30f, 32m), 31 (15f, 16m) were referred to Madang hospital for further investigation. ICD-
11 has a 'diseases of the skin' primary category, but many infectious skin diseases are categorised
elsewhere, mainly as 'certain infectious or parasitic diseases'. Figure 3 compensates by outlining in
red infections or parasitic conditions primarily affecting the skin (30 diagnoses, 17.9% of
morbidities). In addition to tinea imbricata (the second most diagnosed illness overall), tropical ulcers,
scabies, yaws, and post-traumatic wound infections were diagnosed. Multiple participants reported
these substantially affected their life because of itch, pain, disruption of sleep and inability to walk.
Concordance
There was generally strong concordance between diagnoses most frequently made following
assessment, medical histories, and the health issues the community identified as being most important.
For example, three of FGs top four ranked health issues ([a] "malaria"; [b] "sotwin"; [c] "grile".
(1)

Ethnoclassification taxonomies, supplementary tables S3-6, supplementary file, p.6-9), translated to

imbricata. Figure 3). These three FG ranked health issues were also highly represented in declared

the five biomedical conditions we diagnosed most ([a] malaria; [b] URI, LRTI, TB; [c] tinea

medical histories ([a] 75 participants, [b] 23, [c] 35). The remaining of the FGs top four ranked health issues, cancer, was not similarly mirrored in patient histories or clinical diagnoses given.

Existing disease prevention, treatment, and ethnoclassifications

One KI perceived the community had got healthier over the preceding decade due to changes in the village environment and behaviours, specifically: reduced mosquito populations; introduction of covered pit latrines; improved personal hygiene; enhanced nutrition through diversified cropping. An agronomy trained RT noted "almost everyone makes garden and continues to live a subsistence life", and counted 20 crops under cultivation, supplemented by hunting wild pigs and bandicoot (figure 1), and fishing. Males ≥40y described preventing diseases through bathing, not eating rotten food, avoiding rain, and not "working too hard". Males <40y also mentioned care when walking in the forest and working with axes and knives. Females <40y focused discussion of prevention on bathing (both oneself and children) and keeping cookware clean. Mosquito nets and bed sheets were often referred to, but participants believed only half of Wanang were thought to have them; no-one reported re-treating nets. Villagers said they learned about health from mothers, teachers, and through sharing advice given at aid posts or hospital. Participants reported traditional treatments were made at Wanang, biomedical treatments acquired at a neighbouring area's aid post (now usually closed) or from hospital/pharmacy in Madang town. If diseases were treated, which they were often not, a plurality of treatment approaches were used. Whatever was to hand was used first (usually traditional plant-based medicines or stored pharmaceuticals, sometimes rituals), with individuals only leaving Wanang to obtain medicines for severe or refractory disease. FGs and KIs reported that whilst some people were more skilled in plant-medicines than others, there were no specific medical roles in the community, rather everyone knew something, at least for minor ailments:

"we live in the forest so we have information about all little types of forest medicine... we know to take sap from vines [for] coughs... Diarrhoea too can be treated by medicine from the forest... [but] lower abdominal pain doesn't have a forest medicine... you go out to the hospital" (f<40y FG).

Rituals were reported in a patient history and FGs:

"they use a spell... take cold water from the mountain, do a little ritual and "WHSSHHH!"... they can touch the belly button and stomach will no longer be in pain... Cough/cold... tends to stop it completely" (m<40y).

Ability to conduct such practices was reported to be less common, but not specialised to any age/sex group. Some were more cynical, saying sometimes its "proper, sometimes they pretend", and specifying that in "reality these things like malaria or snake bites... shaman/traditional healer from the village will not be able to sort it out" (m≥40y FG). Notably, someone known for skill with traditional treatments articulated this latter view.

The ward councillor reported no aid posts, patrols, or health NGOs operated in the upper Ramu lowlands; an area he estimated to have c8000 persons. To reach the nearest post:

"you have to walk for a day... sleep there, get treatment and then walk back... [but it often doesn't have supplies as] whenever there is a lot of medicine everyone from Musak, Kibirai and Ramu, they all come... the medicine tends to run out in one day" (KI).

Combined with concerns about violence in the neighbouring area, this meant traveling to Madang town in a Public Motor Vehicle or with Binatang Research Centre was often preferred. Maternal mortality is high in PNG, but one KI reported that with road evacuation by Binatang Research Centre:

"in the last five years, not a single mother giving birth... died in childbirth. Because we are safe in the time since conservation work has been occurring, we have [Binatang Research Centre] emergency vehicle tends to come and take us" (KI).

However, improvised stretchers were still required transport for ill/immobile individuals to the roadhead. KIs and FGs discussed further barriers on reaching the provincial hospital, including that it often didn't have sufficient supplies:

"hospitals... are running out of medicines, normally they check the patient... and send them to go to the chemist to buy. So you'll see, when people don't have money how will they... be cured" (KI).

Illiteracy and unfamiliarity with institutions left some unable to navigate the hospital (spatially or bureaucratically), deterring attendance:

"sometimes they afraid come to the hospital because most things are written in English" (KI) "some older women/mothers, they don't tend to go, big hospitals have a lot of wards. When you go inside, you will go back and forth looking over a lot of areas... you will be confused... making you not want to go to the hospital" (f≥40y).

Without an aid post, villagers lacked formal referrals. Given such barriers, participant medical histories and KI reports indicated secondary care attendance was frequently delayed, and clinical diagnosis and treatment bypassed by purchasing medicines from pharmacies for immediate/future use, or simply by not seeking biomedical care despite wishing to do so.

Top four health issues identified by FGs as affecting the community

Ethnoclassification taxonomies for each of the top four health issues identified by FGs are in supplementary tables S3–6 (supplementary file, p.6–9), including example quotes from KIs, FGs, and patient histories on how the diseases are understood, who treats them, and how. Though the belief "sanguma poison" (sorcery) causes some illness was voiced in the m≥40y FG, they seemed in agreement that "malaria... sores, "sotwin" or that kind of thing...are not to do with this." All causes given by FGs and KIs for the top four diseases were biological, none mentioned sorcery as causal. However, two examined participants declared they thought sorcery explained their ailments ("sotwin"; lower body pain), and two others attributed death of some of their children to sorcery.

"Malaria" (table S3, supplementary file, p.6): FGs all used the Tok Pisin and English word "malaria", saying everyone can be affected, though some KIs highlighted children and old people as at particular risk. Mosquitoes were uniformly identified as the "malaria" vector, and linked to sleeping outdoors/without a bed net. However, explanations differed and included biomedically erroneous beliefs (i.e., malaria results from mosquitoes laying their eggs, or transferring pig/dog blood to humans). Listed signs/symptoms aligned with biomedically-labelled malaria. Treatments included doing nothing and resting, "medicine from the forest", pharmacy-drugs, and hospital attendance. Members of f≥40y FG described treatments using steam from boiled plants and fruits. According to the m<40y FG few know how to do this (though it included one of them). One stated pharmaceutical treatment used was amoxicillin which is not an antimalarial drug.[22] A FG and KI described how hospital treatment was sometimes sought for severe cases, using Binatang Research Centre transport when available.

"Sotwin" (table S4, supplementary file, p.7): This Tok Pisin word has a dual meaning as both sign/symptom (shortness of breath), and specific biomedical condition (asthma).[23] Given this, people were likely sometimes describing experiences of conditions beyond asthma (only one case diagnosed on examination). A KI emphasized that without medical support the community cannot differentiate between "TB" or "asthma" for example. On clinical assessment, some who said they had "sotwin" were diagnosed as having respiratory infections, chronic obstructive pulmonary disease, and in one case tuberculosis. Though "TB" was listed by m≥40y (and no other FGs) as a specific health issue, given evident conceptual overlap in Wanang due to lack of diagnostic testing to generate a distinct class of tuberculosis cases, the community's classification of "sotwin" can practically speaking be taken to include "TB" (considered further in discussion). Most FGs, and some KIs, said "sotwin" affected all parts of the community. Others highlighted risk to >5y and youth, or older ages. Causes stated were diverse: smoking; chewing betel nut; cooked meat/fish, or contaminated containers; sex with women (mentioned by both male FGs); proximity to others; rubbish and dust; the sun. Associated signs and symptoms included heavy breathing, difficulties during exercise, and coughing. Some patients presenting with "sotwin" had had no prior treatment, others had used pharmacy drugs. Plant-based oral treatments were described; one person stated child cases could be healed in the village, another that forest medicines usually only work temporarily for "sotwin".

Cancer (table S5, supplementary file, p.8): Three Tok Pisin named cancer types were identified by participants: "susu cancer" (breast cancer), "cancer bodi insait" (cancers inside the body), and "sik bilong ol mama" (cervical cancer). The m≥40y FG was particularly concerned. When asked who is affected, they answered both "a lot of us" and "we don't know ourselves". Such a combination of high concern and declared powerlessness permeated statements about cancer by all those who discussed it. Unlike all other conditions, cancer was uniformly described as something only distant doctors could see or treat. Badly prepared meat and fish, smoking tobacco, and chewing betel nut were given as

 causes. Females <40y were "not sure" of what brings about cervical cancer. Though coughing and flushed skin were mentioned as signs of cancer, the main message was "we find out from the doctor". A linked stated issue was that without primary care to assess community members and provide hospital referrals, subsequent therapy was thought likely to come too late. This was powerfully voiced by one KI whose mother had recently died of cervical cancer after protracted delayed diagnosis. Fear of medical interventions was also seen as a barrier to "cure".

"Grile" (tinea imbricata) (figure 4; table S6, supplementary file, p.9): Also known as "Kavnam" and "Pukpuk". All ages and sexes were said to be affected, younger groups especially (a teacher stated most of her schoolchildren). A f≥40y said she and many others like her hide it. People associated grile with continuing to wear clothes sodden from bathing/rain/sweat. Rivers contaminated with "crocodile skin particles" from affected people bathing or washing clothes upstream were believed by a KI and both male FGs to be responsible. Male FGs and affected individuals associated sharing clothes and co-sleeping with transmission. Differing within-community susceptibility was also suggested (which is in line with some, but not all, observations from PNG that predisposition may be inherited [24–26]). Signs and symptoms reported were "skin like crocodile" (body-wide), scratching, itch, pain.

Treatments included local plants (lime, peppers, tree bud paste; heated tree seeds; papaya) and biomedicine from chemists/hospitals (tolnaftate cream; oral terbinafine). Remission post-treatment was expected, and many go entirely untreated. One m<40y described a traditional practice he'd used: "take a knife and make a hole in a banana plant... put the skin infected with pukpuk inside... now it ends their pukpuk... there is no spoken words or anything". Others listening said this is not a method they use now.

Community identified priorities for health service provision

Table 1 b shows FG identified priorities for service introduction. The highest scoring was aid post sited in Wanang, top for all but f<40y who thought it an unrealistic expectation from government so did not list it. The ward councillor confirmed one had been requested previously but never delivered. KIs were not asked to rank priorities but all strongly called for aid post establishment. For example:

"this is remote area, so the best thing is we must have a aid post. We must because we have too many sicknesses here... [and] there is no hospital or clinic around... an aid post will... benefit many people... That's what we want, we are a community and we are thinking about this for us" (KI).

Child vaccinations ranked next highest, identified by three FGs, but not m<40y. Transport was ranked first by f<40y, a priority by two other FGs. Pregnancy and birth care within the community was vocalised by female FGs and m≥40y, but not m<40y. Jointly scoring with pregnancy and birth care was family planning, identified by f<40y and m≥40y (the latter ranking it their second highest

priority). One KI stated people would welcome family planning services to enable increased birth spacing and reduced family sizes:

"they got no times for body to rest... If they go over six, seven, eight, nine, and ten, that's too much... it's very expensive... to buy clothes and school fee and... for their safety, three children to a father and mother, or four or five, it's enough" (KI).

Whilst not a combined top five, both male FGs ranked health education as a top five (specifically HIV and TB awareness), but neither female FG did. Given opportunity only m≥40y and f<40y identified five priorities (the latter adding fracture management).

DISCUSSION

Principal findings

We established service needs of the community by determining disease burdens and voiced service priorities. Of 113 examined, only 11 were 'well', 62 treated urgently, 31 referred, indicating considerable unmet need. FGs top four ranked health issues strongly concorded with KI views, medical histories, and clinical examinations. For example, ethnoclassifications of three ([a] "malaria", [b] "sotwin", [c] "grile") translated to the five biomedical conditions we diagnosed most ([a] malaria, [b] URI, LRTI, TB, [c] tinea imbricata), and were highly represented in declared medical histories. We built a picture of existing disease prevention and treatment, including who community members think are affected by each of the top four, how they recognise them, what they think causes them, and how they are treated and by whom (answering our subsidiary research questions). FGs generally ascribed their top health issues biological explanations but not always correct ones. Treatment was pluralistic, with whatever was to hand used first (usually plant-medicines/stored pharmaceuticals, sometimes rituals), and travel to hospital/pharmacy reserved for severe/refractory disease. Plantmedicines were considered common knowledge, healing rituals less so. Stated barriers to biomedical services included: no local health patrols or easily reachable aid post; remote town hospital; unfamiliarity with institutions; medicine costs. Given these barriers, attendance was frequently delayed, clinical diagnosis and treatment bypassed by purchasing familiar (not always appropriate) drugs from pharmacies for immediate/future use, or biomedical care was simply not sought (despite stated desire). FG health service priorities were: aid post, child vaccinations; transport; pregnancy and birth care; family planning; health education; fracture management. In a community with no prior patient data, this study enabled service planning and demonstrated medical need sufficient for us to successfully acquire funding for establishment of primary care services sited in the community, and target some of the lead health issues identified.

Strengths and weaknesses

Study strengths include its cost-effective time frame, and a mixed-method approach that increases confidence in findings by triangulating qualitative and quantitative data. However, speed was also a

limitation as we inevitably overlooked social nuance that slower ethnography may have identified. KI selection was biased towards highly influential, mostly male individuals in Wanang to obtain perspectives of those with influence who could facilitate or block interventions. However, this limitation is balanced by individual clinical discussions and age-sex segregated FGs, across which most adult villagers participated. Importantly, these provided opportunity to talk freely, unobserved by fellow-villagers from other sexes or age-groups. We examined most of the population of Wanang but loss of some of those triaged towards the end of a multi-day queue is likely to have biased the sample towards those with greater morbidity. In our protocol paper[4] we describe strengths and weaknesses of rapid anthropological assessment procedures in health research including those of our study. Many previous studies using this methodology have been based on disease prioritisations set by global 'vertical health programmes' [27] (e.g., HIV, guinea worm [13]). In contrast, our research was initiated following a community request, better supporting community-led service planning. Our broad focus reduces capacity to detect some health burdens as accurately as single-disease targeted research. A strength compared to assessments without clinical components, was parallel treatment of urgent cases. Collecting data on Wanang's health burdens can be expected to benefit those of us employed as professional researchers and our institutions. Health service implementation had not been secured at the time of data collection and treatment provision went someway to making the relationship between the community and researchers a fair transaction, rather than one of dispossession and accumulation as West[28] has characterised some foreign-driven research and NGO activity in PNG.

Some who participated in primary care assessments were classified as 'well', a clinical impression based primarily on self/parent declarations of no current illness (i.e., answering "nogat" ['no'] to the question "Yu gat sampela sik nau yet?" ['Do you currently suffer from any illness?']), but also appraisal of medical histories, conversation with the persons, and not observing signs of disease. In Tok Pisin one might say 'malaria I kisim em, tassel nau i **orait** gen' ('he had malaria, but now he's well again' [23]). It is broadly in this vein we are using 'well'. We do not mean it in the more holistic sense, such as that signalled by the WHO definition of health ('complete physical, mental and social well-being and not merely the absence of disease' [29]), nor have we attempted to create an ethnoclassification of what it means in Wanang to be 'well'. Instead, we just mean a clinical impression of absence of disease (expressed or observed). This narrow usage, similar in form to 'Sick/Not Sick' in emergency patient assessment, [30] was appropriate given our main objective in conducting primary care assessments was to determine disease burdens at the community level, as part of planning health service introduction. Others have investigated and discussed ways communities in PNG socio-culturally understand concepts translatable to well-being or health, and how they relate to biomedical ideas (for example, see [31–33]). Especially pertinent, given our aim to support a locally driven sustainable development pathway, is the expansive view of another forest

people of PNG, the Huli. According to a letter co-authored by one of their community: 'if their environment is not considered healthy, so the community and each individual in itself are not healthy... According to the Huli conceptions, health is not limited to their bodies, it encompasses their land and all that surrounds them.'[33] Determining how people at Wanang understand what it means to them to be well/healthy would be useful (particularly to support long-term health promotion activities), but it was beyond the narrow remit or capacity of this rapid needs assessment.

Ours is the only health assessment of Wanang village, and the most comprehensive study of a

community's general health in the rainforests of Madang province. Many high burden illnesses identified in our study reflect those seen regionally and nationwide. For example, malaria was one of the five most common diagnoses we gave, in the declared medical histories of over half of our participants, and trackable to the highest community-ranked health issue. Beyond Wanang, it is widespread in lowland and coastal provinces, including Madang.[34] In 2021 PNG accounted for nearly 87% of malaria cases and 94% of associated deaths across the entire WHO Western Pacific Region.[35] This is an area of 37 countries and territories in which live 1.9 billion people.[36] Similarly, GBD 2019 ranks respiratory infection as the leading cause of all-age PNG DALYs.[37] This chimes with our findings in Wanang that URI and LRTI were two of the five most common diagnoses we gave, and trackable to the second highest community-ranked health issue ("sotwin"). Unfortunately, beyond select diseases such as malaria that are the target of international action (and therefore have resources allocated to collect well-grounded indicators), there is limited reliable national or province-level statistics available to compare our community-level findings with. This is particularly so re disease prevalence beyond towns and areas well-connected to them by road. To put this in context, in Madang province only an estimated 3% of child births are registered (the lowest in the country),[38] whilst at the other end of life only an estimated 26% of deaths nationally are recorded by health services. Most of these are from urban areas and without medical certification, so not reliable for developing national mortality statistics.[39] Treatment data from a large subset of health centres is in the process of being pooled nationally, [40] but is not yet available for comparison. Likewise at a provincial level, aggregation and digitisation of datum from health facilities across Madang is planned but presently (August 2023) faces logistical issues which mean regional treatment data is also unavailable for comparison.

Community perspectives and ethnoclassifications outlined in our study resonate with some voiced elsewhere in PNG (particularly Whittaker et al.[41]), however we caution against extrapolating beyond Wanang. PNG is hugely diverse culturally (it has more languages than any other nation on earth[42]) and biogeographically (lowland forests, peri-urban slums, swamplands, high mountains, island archipelagos), and its communities have markedly different levels of engagement with state, industry, and the money economy. The myriad eco-cultural 'entanglements' (in the sense used by

Nading[43] and Tsing[44]) resulting from these diversities militate against generalisations about PNG's disease ecologies. Nevertheless, given this kind of health assessment is otherwise absent in the region, our results may be usefully indicative of similar settings elsewhere in inland Madang province in communities to which biomedical care remains remote. Notably, a recent PNG statistical office survey [38] asked women about difficulties accessing healthcare. Across Madang province 77% of rural women respondents 15–49y reported 'serious problems in accessing health care for themselves'. The leading barriers were needing to get money for treatment (70%), and distance to health facilities (61%). This resonates with our related findings from Wanang. (For insights into settings in the region where medicine is less remote, see Street [11] on relations within and around a hospital in Madang town.) In conclusion, whilst generalisability is limited, given participation levels and composition the sample is representative of Wanang sufficient to fulfil the study aim (to co-plan health service incorporation into the conservation collaboration), and given this kind of health assessment is otherwise absent in the region our results imply substantial unmet medical needs might be found in other forest communities across Madang Province.

Implications for clinicians and policymakers

Wanang health service plan

Health needs assessments commonly make recommendations for clinicians or policymakers to act on identified needs. However, here there were no clinicians providing in-community care to advise, and no expectation from participants that local government would act to establish such services. Given this, any intervention would be by the conservation collaboration itself, and thus this exercise had always been understood as a process by which the community and its academic allies in the collaboration co-plan action together. We outline here the plan for health service introduction developed, and its rationale. Based on clinical observations and voiced community perspectives, targeting malaria, respiratory issues, tinea imbricata, and maternal and child health were clear priorities. Disease-specific actions such as bed-nets, high vaccination coverage, and Mass Drug Administration (MDAs) carried out without permanent infrastructure or staffing could potentially reduce these burdens. However, there was clear community demand for a full-time staffed aid post, and our assessment was that the most effective and sustainable treatment of these burdens would necessitate permanent biomedical health provision sited within the community. This could improve diagnostic certainty and medicine supply, and provide clinician-led treatment, follow-up, and referrals. In addition, while examinations confirmed community-identified health issues were key burdens, over a quarter of diagnoses were for conditions seen in only one or two people. This argued strongly for a holistic primary care approach, rather than just targeting high-prevalence diseases. We concluded to set-up an aid post at Wanang, yet given this could be expected to take time and our assessment demonstrated substantial health burdens, 'holding action' was needed to empower community members to act on identified needs in the meantime. Once established, the aid post could

be used as a base for proactive measures in the surrounding communities, targeting the high priority burdens identified here, rather than providing responsive-only treatment. Our plan thus has three-phases (figure 4; detailed in box 1), with on-road evacuation from trailheads continuing to be provided by Binatang Research Centre when possible.

Phases 1 and 2 are complete. We used this study's evidence to obtain Darwin Initiative (https://www.darwininitiative.org.uk/) funding for aid post construction, supply, and nurse staffing as part of a 3-year integrated health and conservation project.[45] As holding action, in 2019 first author JM returned to Wanang and trained community members in off-road medical evacuation, and self-treatment of malaria, tinea imbricata, and fractures (figure 4). The aid post was then built and opened at end of 2020, registered with the provincial health authority, and continues to be staffed by a full-time nurse (figure 4). Given PNG's health care shortages, Wanang's population wouldn't be large enough to secure government financial support after project funding ends. However, the total population of the communities including Wanang in the government ward area is c2000 people. Thus, the establishment of an aid post at Wanang was in line with aspirations of PNG's Medium-Term Development Plan, which aimed to have an aid post operational in every ward, serving populations of up to c2000 people each[7]. The provincial health authority has undertaken to fund the nurse's salary and aid post supplies at the end of the Darwin Initiative funding, ensuring the long-term sustainability of this health service initiative.

COVID-19

 Two authors of this paper (ML, WP) have co-authored with colleagues a report assessing COVID-19 impacts on PNG's primary health services and public health infectious disease programs. [46] One key identified theme at a national level is especially relevant to the local findings and recommendations of our study. Newland et al. [46] found the scaling back of some services and reduced ability to travel to facilities for both staff and those seeking medical services (particularly during lockdowns) impacted access to and continuity of care. However, locally in our study area, during the pandemic access to and continuity of care increased due to the operationalising of a key study recommendation, that permanent primary care be established for the Wanang area. When the aid post opened (November 2020) few cases had been seen nationwide compared to many other countries at the time, and it was prior to PNG's two main waves of COVID-19 infections and death (both in 2021).[46] Continuity of care amidst the pandemic was mainly possible because the nurses lived amongst the people they treated. Other approaches we considered, such as only providing medical patrols from outside the area, may have served the communities less well in the context of a pandemic when many mobile health programs closed due to workforce re-tasking and restrictions on travel. [46] As of August 2023, no cases of COVID-19 have been identified in Wanang, but this is not verifiable due to limitations on testing capacity in PNG.

Integrating action on health and conservation

As well as supporting the conservation community at Wanang, the establishment of an aid post powerfully demonstrated to surrounding communities the benefits of forest preservation, directly leading new clans to join the collaboration and commit to refuse secondary logging of regenerating previously selectively logged forest (expected to commence 2025). This has directly resulted in expansion of the conservation area from 100 km² to 150 km². Beyond the direct findings of our health needs assessment, this then has implications for policymakers and others looking to identify innovative ways to make progress on the Sustainable Development Goals (SDGs), which are mostly implemented individually[47]. The impacts of this work indicate simultaneously addressing health (SDG 3) and biodiversity (SDG 15) can be a successful 'synergy driver'[47] to advance SDGs. We welcome conversations with anyone who wishes to take such integrated approaches.

Challenges of translating between ethnoclassifications and biomedicine

An implication of our study for clinical researchers is to play close attention to meanings within local disease terms/ethnoclassifications, not leaning too heavily on simple linguistic translation to biomedical diagnostic categories. As "sotwin" illustrated, ethnoclassification terms may hold dual meanings as both symptom/sign and specific medical conditions. Straight-forward translation as asthma would have hidden that participants were describing a constellation of respiratory illnesses (as examinations confirmed). Risk of false conflation may be especially high when ethnoclassification terms resemble or are identical to biomedical ones, such as with 'tibi', which is sometimes used for severe respiratory conditions other than pulmonary TB/tuberculosis.[48] Similarly, "malaria" may seem simple to translate; the Tok Pisin dictionary definition of "malaria" equals malaria in English.[23] However, in practice it is often used generally to mean fever.[41] This is clinically important as non-malarial febrile illnesses are widespread in PNG,[49] underlining the potential value of RDTs in determining when "malaria" is malarial, to avoid inappropriate treatment (which is common [50]). Translational issues between ethnoclassifications and biomedicine are particularly prevalent in PNG,[41, 51, 52] but are found generally. We suggest publications from similar settings (specifically those seeking to (1) describe community perspectives on diseases, or (2) generate nonclinically corroborated prevalence estimates from community surveys) state more often how meanings encoded in local terms have been translated into biomedical categories (and vice versa).

Unanswered questions and future research

Long-term ethnography could improve understanding of disease ethnoclassifications, especially beyond the 'top four', and explore local ideas related to biomedical conceptions of health. Studies to determine effectiveness of traditional treatments would be helpful (we discuss ethical issues elsewhere[45]). An audit of the now established aid post would support further development, and given its large catchment area beyond Wanang village could aid determination of how representative

this study's findings are of surrounding forest communities. Comparison with health data from communities elsewhere (which in the last few years have started to be nationally pooled [40]) may usefully indicate commonalities and differences. Implementation studies of planned disease specific interventions would be useful service evaluations, potentially with wider value. This may be particularly so for action on neglected tropical skin diseases, which are highly prevalent across the Pacific.[53] The region has been key to developing integrated skin interventions to control scabies and reduce soft tissue infections.[54] Tinea imbricata, which is only found in a small number of populations worldwide but is highly distributed across Melanesia, [26, 55, 56] has been neglected as regards research and treatment [24]. An integrated skin intervention [57] in Wanang and surrounding areas, targeting tinea imbricata alongside yaws, tropical ulcers and scabies (figure 4), may relieve nd act c. considerable suffering, and act as a model for the region and beyond.

Box 1. Community Health Plan for Wanang Conservation Area

Phase 1: Training and supplies to support community members acting on needs before aid post establishment: (i) malaria treatment (including RDTs, appropriate medications, evacuation triggers), (ii) fracture management, (iii) off-road medical evacuation, (iv) tinea imbricata treatment.

Phase 2: Construct, supply, and staff an aid post to introduce responsive primary care, managed by a community health committee with equal sex representation and involvement of those who have provided traditional treatments. Obtain provincial health authority aid post registration and commitment to provide supplies and nurse salary beyond grant period. In addition, the nurse should facilitate childhood vaccinations, and pregnancy and emergency birth care (with telemedicine-based support when available). To enable the latter, the aid post should have a mobile phone (with solar charging) with which to seek advice from obstetrics at Madang hospital when sufficiently timely evacuation is not available. The recently introduced mobile coverage of the area remains weak and patchy, so the aid post should be sited in the highest part of the settlement to maximise reception. To support continuity of care (and treatment auditing) patient-level data should be recorded and securely stored at the aid post, in addition to individually retained health books. Onroad evacuation from trailheads can be provided by Binatang Research Centre when possible, with the pre-existing good quality High Frequency radio link between the centre and Wanang maintained to support this.

Phase 3: Once established, the aid post should conduct disease specific interventions and mobile patrols (reaching c2000 people), acting on identified community health burdens and service priorities (in addition to routine treatment). Specifically, (i) Malaria: mosquito net audit, supply, and re-treatment; elsewhere ivermectin MDAs have reduced vector populations and thus human cases, [58] local trials may be beneficial, particularly combined with MDAs on neglected tropical skin diseases already including ivermectin (see iv). (ii) Respiratory issues: preventive child vaccinations; TB screening and referrals; RDTs should guide appropriate treatment given PNG wide shifts from bacterial to viral lung infections and pneumonia. (iii) Cancer: in addition to aid post referrals, preventive (both-sex) HPV vaccinations could be introduced (if supplies imported) as PNG has a higher-than-average burden of cervical cancer for comparable nations and it is thought to be the second leading cause of cancer in the country.[59-61] (iv) Tinea imbricata and other skin infections: joint-MDAs and targeted follow-ups for yaws, tinea imbricata, impetigo, and scabies; introduction of ethnomedicine treatments for tropical ulcers already trialled elsewhere in PNG.[62] (v) Family planning: facilitate Marie Stopes mobile clinic visit. (vi) Pregnancy related anaemia: birth spacing; other solutions are not evident given local genetic predisposition to anaemia is partially protective against malaria, and iron supplementation can be expected to have

negative impacts while infection rates remain high.[63, 64] (vii) Health education: nurse-provided STD training sessions; exercises for youth to reduce sports related lower back pain. (viii) Mobile patrols: nurse-led patrols to reach villages across the aid post catchment area.



STATEMENTS

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- **Contributors:** Author order is alphabetical by surname, except first and last. Co-Investigator
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- 721 Data availability statement: All data relevant to the study are included in the article or uploaded as
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728 REFERENCES

- 1. Lim SS, Allen K, Bhutta ZA, *et al.* Measuring the health-related Sustainable Development Goals
- in 188 countries: a baseline analysis from the Global Burden of Disease Study 2015. *Lancet*
- 731 2016;**388**:1813–50. https://doi.org/10.1016/S0140-6736(16)31467-2
- 2. Shearman P, Bryan J. A bioregional analysis of the distribution of rainforest cover, deforestation
- and degradation in Papua New Guinea. *Austral Ecology* 2011;**36**:9–24.
- 734 https://doi.org/10.1111/j.1442-9993.2010.02111.x
- 3. Novotny V, Toko P. Ecological research in Papua New Guinean rainforests: Insects, plants and
- people. In: Bryan JE, Shearman PL, eds. The state of the forests of Papua New Guinea 2014:
- Measuring change over period 2002–2014. Port Moresby, Papua New Guinea: University of
- 738 Papua New Guinea 2015:71–85.
- 4. Middleton J, Abdad MY, Beauchamp E, et al. Health service needs and perspectives of remote
- forest communities in Papua New Guinea: study protocol for combined clinical and rapid
- anthropological assessments with parallel treatment of urgent cases. *BMJ Open* 2020;**10**:e041784.
- 742 https://doi.org/10.1136/bmjopen-2020-041784
- 743 5. Thomas H. The Expedition as a Cultural Form: On the Structure of Exploratory Journeys as
 - Revealed by the Australian Explorations of Ludwig Leichhardt. In: Thomas H, ed. Expedition
- into Empire: Exploratory Journeys and the Making of the Modern World. New York: Routledge
- 746 2019:65–97.
- 6. Hviding E, Cato B, eds. The Ethnographic Experiment: A.M. Hocart and W.H.R. Rivers in Island
- Melanesia, 1908. New York and Oxford: Berghahn Books 2014.

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- 749 7. Grundy J, Dakulala P, Wai K, et al. Papua New Guinea Health System Review (Vol. 9, No.1).
- New Delhi: World Health Organization, Regional Office for South-East Asia 2019.
- 751 8. Brown AN, Gilbert B. The Papua New Guinea medical supply system: documenting opportunities
- and challenges to meet the Millennium Development Goals. *J Pharm Policy and Pract* 2014:7.
- 753 <u>https://doi.org/10.1186/2052-3211-7-5</u>
- 9. Stewart A, Peck M, Novotny V. Final report to the Waterloo Foundation (July 2016): Creating
- sustainable livelihoods whilst protecting rainforest in Papua New Guinea (PNG) from logging.
- Falmer, UK: University of Sussex, 2016.
- 757 10. Stockdale J, Cassell JA, Ford E. "Giving something back": A systematic review and ethical
- enquiry into public views on the use of patient data for research in the United Kingdom and the
- Republic of Ireland. *Wellcome Open Res* 2019;**3**.
- 760 <u>https://doi.org/10.12688/wellcomeopenres.13531.2</u>
- 11. Street A. Biomedicine in an unstable place: Infrastructure and personhood in a Papua New
- Guinean hospital. Durham: Duke University Press 2014.
- 12. Middleton J, Cassell JA, Novotny V, et al. Surfaces: an interdisciplinary project to understand and
- enhance health in the vulnerable rainforests of Papua New Guinea. Inaugural Planetary Health /
- GeoHealth Annual Meeting, 28–30 April 2017, Harvard Medical School, Boston, USA. Available
- from: http://sro.sussex.ac.uk/67423 (accessed 18 September 2022).
- 13. Utarini A, Winkvist A, Pelto G. Appraising studies in health using rapid assessment procedures
- 768 (RAP): Eleven critical criteria. *Hum Organ* 2001;**60**:390–400.
- 769 https://doi.org/10.17730/humo.60.4.3xu3p85amf13avtp
- 14. Institute of Development Studies Participation Research Cluster. Resources [Internet]. 2022
- 771 [accessed 28 August 2022]. https://www.participatorymethods.org/resources.
- 772 15. Daniels D. Magi: An undocumented language of Papua New Guinea. Ocean Linguist
- 773 2016;55:199–224.
- 16. Pawley A, Hammarström H. The Trans New Guinea family. In: Palmer B, ed. The Languages and
- Linguistics of the New Guinea Area: A Comprehensive Guide. Berlin: De Gruyter 2017: 21–196.
- 17. Middleton J, Abdad MY, Beauchamp E, et al. Supplemenary File for Health service needs and
- perspectives of remote forest communities in Papua New Guinea: study protocol for combined
- clinical and rapid anthropological assessments with parallel treatment of urgent cases. *BMJ Open*
- 779 2020;**10**. https://bmjopen.bmj.com/content/bmjopen/10/10/e041784/DC1/embed/inline-
- supplementary-material-1.pdf?download=true
- 18. Gallagher M, Hares T, Spencer J, et al. The Nominal Group Technique: A Research Tool for
- 782 General Practice? *Fam Pract* 1993;**10**:76–81.
- 783 19. Scrimshaw S, Hurtado E. Rapid assessment procedures for nutrition and primary health care:
- Anthropological approaches to improving programme effectiveness. Los Angeles: University of
- 785 California 1987.

- 786 20. Goldsmith, LJ. Using Framework Analysis in Applied Qualitative Research. *Qual Rep*
- 787 2021;**26**:2061–2076. https://doi.org/10.46743/2160-3715/2021.5011
- 788 21. WHO. International Classification of Diseases (11th Revision) for Mortality and Morbidity
- Statistics (Version: 02/2022). Geneva: World Health Organization 2022. Available at:
- 790 <u>https://icd.who.int/browse11/l-m/en</u> (accessed 16 July 2022).
- 791 22. Sié A, Dah C, Ourohiré M, et al. Azithromycin versus Amoxicillin and Malarial Parasitemia
- among Children with Uncomplicated Severe Acute Malnutrition: A Randomized Controlled Trial.
- *A J Trop Med Hyg* 2021;**106**:351–355. <u>https://doi.org/10.4269/ajtmh.21-0595</u>
- 794 23. Volker CA, ed. Papua New Guinea Tok Pisin English Dictionary. Melbourne: Oxford University
- 795 Press 2008.

- 796 24. Er YX, Lee SC, Than LT-L, et al. Tinea Imbricata among the Indigenous Communities: Current
- Global Epidemiology and Research Gaps Associated with Host Genetics and Skin Microbiota. *J*
- 798 Fungi 2022; 8:202. https://doi.org/10.3390/jof8020202
- 799 25. Hay RJ. Genetic Susceptibility to Dermatophytosis. Eur J Epidemiol 1992;8:346–349.
- https://doi.org/10.1007/BF00158566
- 26. Hay RJ. Tinea Imbricata. In: McGinnis MR, ed. Current Topics in Medical Mycology, vol 2. New
- York: Springer 1988:55–72. https://doi.org/10.1007/978-1-4612-3730-3_3
- 27. De Maeseneer J, van Weel C, Egilman D, et al. Strengthening primary care: addressing the
- disparity between vertical and horizontal investment. *Br J Gen Pract* 2008;**58**:3–4.
- 805 https://doi.org/10.3399/bjgp08X263721
- 806 28. West P. Dispossession and the Environment: Rhetoric and Inequality in Papua New Guinea. New
- York and Chichester: Columbia University Press 2016.
- 808 29. WHO. Constitution of the World Health Organization. Available at:
- https://www.who.int/about/governance/constitution (accessed 10 August 2023).
- 30. Helbock M. Sick Not Sick: A guide to rapid patient assessment. Sudbury, MA: American
- Academy of Orthopaedic Surgeons and Jones and Bartlett 2000.
- 812 31. Hinton R, Earnest J. Assessing women's understandings of health in rural Papua New Guinea:
- 813 Implications for health policy and practice. Asia Pac Worldview 2011;52:178–
- 814 193. https://doi.org/10.1111/j.1467-8373.2011.01449.x
- 32. Koczberski G, Curry GN. Sik Bilong Ples: an Exploration of Meanings of Illness and Well-Being
- Amongst the Wosera Abelam of Papua New Guinea. *Aust Geogr Stud* 1999;**37**: 230–247.
- 817 https://doi.org/10.1111/1467-8470.00081
- 33. Charlier P, Coppens Y, Malaurie J, et al. A new definition of health? An open letter of
- autochthonous peoples and medical anthropologists to the WHO. Eur J of Intern 2017;37:33–37.
- https://doi.org/10.1016/j.ejim.2016.06.027.

- 34. Keven JB, Katusele M, Vinit R, et al. Vector composition, abundance, biting patterns and malaria
- transmission intensity in Madang, Papua New Guinea: assessment after 7 years of an LLIN-based
- malaria control programme. *Malar J* 2022;**21**:7. https://doi.org/10.1186/s12936-021-04030-4
- 35. WHO. World Malaria Report 2022. Geneva: World Health Organization, 2022.
- 825 36. WHO. Western Pacific Region. Available at:
- https://web.archive.org/web/20230804152140/https://www.who.int/westernpacific (accessed 4
- 827 August 2023).
- 37. Institute for Health Metrics and Evaluation. GBD (Global Burden of Disease) Compare Tool,
- Papua New Guinea. Both sexes, all ages, 2019, DALYs. Washington.
- https://vizhub.healthdata.org/gbd-compare/ (accessed 21 Oct 2022).
- 38. PNG National Statistical Office. Papua New Guinea Demographic and Health Survey 2016–18.
- Port Moresby and Rockville: NSO and ICF 2019. Available at
- https://web.archive.org/web/20230801120444/https://dhsprogram.com/pubs/pdf/FR364/FR364.pd
- $\underline{\mathbf{f}}$ (accessed 3 August 2023).
- 39. Hart JD, Kwa V, Dakulala P, et al. How advanced is the epidemiological transition in Papua New
- Guinea? New evidence from verbal autopsy. *I J Epidemiol* 2021;**50**:2058–
- 837 2069. https://doi.org/10.1093/ije/dyab088
- 40. Rosewell A, Shearman P, Ramamurthy S, Akers R. Transforming the health information system
- using mobile and geographic information technologies, Papua New Guinea. *Bull World Health*
- *Organ* 2021;**99**:381–387. http://doi.org/10.2471/BLT.20.267823
- 41. Whittaker M, Piliwas L, Agale J, et al. Beyond the Numbers: Papua New Guinean Perspectives
- on the Major Health Conditions and Programs of the Country. *PNG Med J* 2009;**52**:96–113.
- https://search.informit.org/doi/10.3316/informit.300656919646201
- 42. Novotny V. Island of a thousand tongues and a wild, wild landscape. In: Notebooks from New
- Guinea: reflections on life, nature, and science from the depths of the rainforest. Oxford: Oxford
- 846 University Press 2011:11–51.
- 43. Nading, AM. Humans, animals, and health: from ecology to entanglement. *Environ Soc*
- 848 2013;4:60–78. https://doi.org/10.3167/ares.2013.040105
- 44. Tsing AL. Enabling entanglements. In: The mushroom at the end of the world: on the possibility
- of life in capitalist ruins. Princeton and Woodstock: Princeton University Press 2015: vii-xiii.
- 851 https://doi.org/10.2307/j.ctvc77bcc
- 45. Middleton J, Cassell JA, Colthart G, et al. Rationale, experience and ethical considerations
- underpinning integrated actions to further global goals for health and land biodiversity in Papua
- New Guinea. Sustain Sci 2020;15:1653–1664. https://doi.org/10.1007/s11625-020-00805-x
- 46. Newland J, Neuendorf N, Vallely L, et al. COVID-19 and its impacts on primary health services
- and public health infectious disease programs in Papua New Guinea. Goroka and Sydney:
- PNGIMR and UNSW 2022. http://dx.doi.org/10.26190/6mhp-gc18

- 47. Alcamo J, Thompson J, Alexander A, *et al*. Analysing interactions among the sustainable
- development goals: findings and emerging issues from local and global studies. Sustain
- *Sci* 2020;**15**:1561–1572. https://doi.org/10.1007/s11625-020-00875-x
- 48. Hamnett MP, Connell J. Diagnosis and cure: The resort to traditional and modern medical
- practitioners in the North Solomons, Papua New Guinea. *Soc Sci Med-Med* 1981;**15**:489–498.
- 863 <u>https://doi.org/10.1016/0160-7987(81)90023-5</u>
- 49. Saweri OPM, Hetzel MW, Mueller I, et al. The treatment of non-malarial febrile illness in Papua
- New Guinea: findings from cross sectional and longitudinal studies of health worker practice.
- 866 BMC Health Serv Res 2017;17:10. https://doi.org/10.1186/s12913-016-1965-6
- 50. Joshua IB, Passmore PR, Parsons R, Sunderland VB. Appropriateness of prescribing in selected
- healthcare facilities in Papua New Guinea. *Health Policy Plann* 2014;**29**:257–65.
- 869 <u>https://doi.org/10.1093/heapol/czt012</u>
- 51. Lewis G. The ethnography of an illness. In: A failure of treatment. Oxford: Oxford University
- 871 Press 2005:1–16.

- 52. Frankel S, Lewis G, eds. A Continuing Trial of Treatment: Medical Pluralism in Papua New
- Guinea. Dordrecht: Kluwer Academic Publishers 1989.
- 53. Kline K, McCarthy JS, Pearson M, Loukas A, Hotez PJ. Neglected Tropical Diseases of Oceania:
- Review of Their Prevalence, Distribution, and Opportunities for Control. *PLoS Negl Trop Dis*
- 876 2013;7: e1755. https://doi.org/10.1371/journal.pntd.0001755
- 54. Middleton J. Can ivermectin mass drug administrations to control scabies also reduce skin and
- soft tissue infections? Hospitalizations and primary care presentations lower after a large-scale
- trial in Fiji. Lancet Reg Health West Pac 2022;22:100454.
- https://doi.org/10.1016/j.lanwpc.2022.100454
- 881 55. Bonifaz A, Archer-Dubon C, Saúl A. Tinea imbricata or Tokelau. *Int J Dermatol* 2004;**43**:505–
- 882 510. https://doi.org/10.1111/j.1365-4632.2004.02171.x
- 883 56. Angra K, Norton SA. Early Western observations of cutaneous *Trichophyton concentricum*
- 884 infection in the Pacific and a history of its vernacular name, tokelau. Australas J Dermatol
- 885 2016;**57**:e108–11. https://doi.org/10.1111/ajd.12322
- 57. Engelman D, Fuller LC, Solomon AW, et al. Opportunities for Integrated Control of Neglected
- Tropical Diseases That Affect the Skin. *Trends Parasitol* 2016;**32**:843–854.
- https://doi.org/10.1016/j.pt.2016.08.005
- 58. Foy BD, Alout H, Seman JA, et al. Efficacy and risk of harms of repeat ivermeetin mass drug
- administrations for control of malaria (RIMDAMAL): a cluster-randomised trial. *Lancet*
- 891 2019;**393**:1517–1526. https://doi.org/10.1016/S0140-6736(18)32321-3
- 59. Nguyen DTN, Simms KT, Keane A, et al. Towards the elimination of cervical cancer in low-
- income and lower-middle-income countries: modelled evaluation of the effectiveness and cost-

894	effectiveness of point-of-care HPV self-collected screening and treatment in Papua New Guinea.
895	BMJ Global Health 2022;7:e007380. http://dx.doi.org/10.1136/bmjgh-2021-007380
896	60. Kelly-Hanku A, Newland J, Aggleton P, et al. HPV vaccination in Papua New Guinea to prevent

- 60. Kelly-Hanku A, Newland J, Aggleton P, et al. HPV vaccination in Papua New Guinea to prevent cervical cancer in women: Gender, sexual morality, outsiders and the de-feminization of the HPV vaccine. Papillomavirus Res 2019;8:100171. https://doi.org/10.1016/j.pvr.2019.100171
- 61. ICO/IARC Information Centre on HPV and Cancer. Papua New Guinea Human Papillomavirus
 and Related Cancers, Fact Sheet 2021. Barcelona,
 https://hpvcentre.net/statistics/reports/PNG_FS.pdf
- 902 62. Prescott TAK, Homot P, Lundy FT, et al. Tropical ulcer plant treatments used by Papua New
 903 Guinea's Apsokok nomads. J Ethnopharmacol 2017;205:240–245.
 904 https://doi.org/10.1016/j.jep.2017.05.001
- Oppenheimer SJ, Hill AV, Gibson FD, Macfarlane SB, Moody JB, Pringle J. The interaction of alpha thalassaemia with malaria. *Trans R Soc Trop Med Hyg* 1987;81:322–6.
 https://doi.org/10.1016/0035-9203(87)90253-7
- 908 64. Oppenheimer SJ, Gibson FD, Macfarlane SB, et al. Iron supplementation increases prevalence
 909 and effects of malaria: report on clinical studies in Papua New Guinea. Trans R Soc Trop Med
 910 Hyg 1986;80:603–12. https://doi.org/10.1016/0035-9203(86)90154-9

FIGURES

Figure 1. Study setting

- A: Overgrown logging road on the way to Wanang. B: Wanang area. C: Mural honouring the role of aid posts in
- PNG medicine on the wall of Madang Provincial Hospital. D & E: Examples of individual health books in-use
- 917 in-region at the time of this assessment. F: Traditional house in Wanang village. G: New Guinea common spiny
- bandicoot (*Echymipera kalubu*). Credit: A, C, D, E, and F, first author JM; B, co-author JP; G, Daniel Heuclin
- 919 (SuperStock).

920 Figure 2. Methodological approach, participants, and resulting plan of health service provision

- 921 Green boxes are outputs: dark, delivered as part of this assessment; light, requiring additional funding for
- 922 provision. Role abbreviations: PC HCP, primary care health care professional (in this assessment a General
- 923 Practitioner); RTs, research technicians; RF, research fellow.

Figure 3. Clinical results of primary care assessments at Wanang

- 925 113 Wanang villagers examined (51 females, 62 males), 168 diagnoses given (not including 11 classifications of
- 926 'well'). The proportion of each concentric circle relates to the proportion a diagnosis was given as part of the
- 927 total number of diagnoses, with categories arranged clockwise high to low. The inner circle shows ICD-11
- 928 primary categories, the outer circle ICD-11 specific conditions (or ICD-11 symptoms/signs/clinical findings)

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with number of diagnoses given for each. Infections/parasitic conditions primarily affecting skin are outlined in
red. * Developmental. † Ear/mastoid process. ‡ Factors influencing health status/contact with services. §
Mental, behavioural or neurodevelopmental disorders. I Sleep-wake disorders. External causes of
morbidity/mortality.

Figure 4. Phased health service introduction at Wanang

Examples of training provided: fracture management (A), off-road vacuum-stretcher evacuation (B). Wanang
Aid Post, outside with a northern cassowary (Casuarius unappendiculatus) chick (C)) and backrooms for nurse
consultations (D). Examples of disease targets for proactive integrated interventions, tropical ulcer (E), yaws
(F), tinea imbricata (G), scabies mite and eggs (H). Images from Madang Province in PNG (specifically: A,
Baitabag; B, Nagada; C, D, E, F and H, Wanang) apart from Sarcoptes Scabiei microscopy (H). Credit: A, D, E
F, and H, first author JM; B and G, co-author JAS; C, co-author VN. Photographic consents were provided by
individuals pictured.

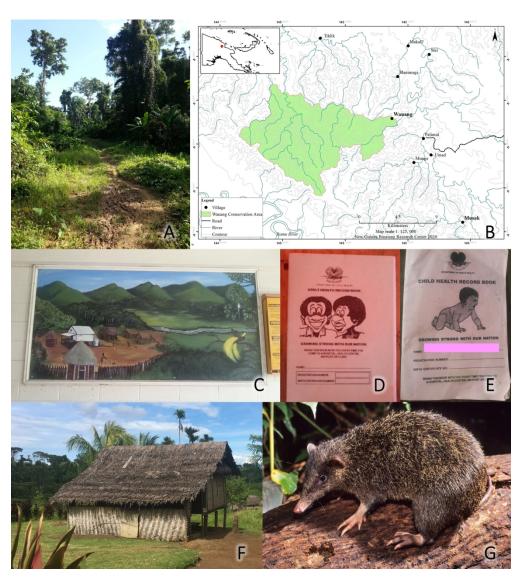


Figure 1 Study setting. A: Overgrown logging road on the way to Wanang. B: Wanang area. C: Mural honouring the role of aid posts in PNG medicine on the wall of Madang Provincial Hospital. D & E: Examples of individual health books in-use in-region at the time of this assessment. F: Traditional house in Wanang village. G: New Guinea common spiny bandicoot (*Echymipera kalubu*). Credit: A, C, D, E, and F, first author JM; B, co-author JP; G, Daniel Heuclin (SuperStock), rights retained.

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Figure 2 Methodological approach, participants, and resulting plan of health service provision. Green boxes are outputs: dark, delivered as part of this assessment; light, requiring additional funding for provision. Role abbreviations: PC HCP, primary care health care professional (in this assessment a General Practitioner); RTs, research technicians; RF, research fellow.

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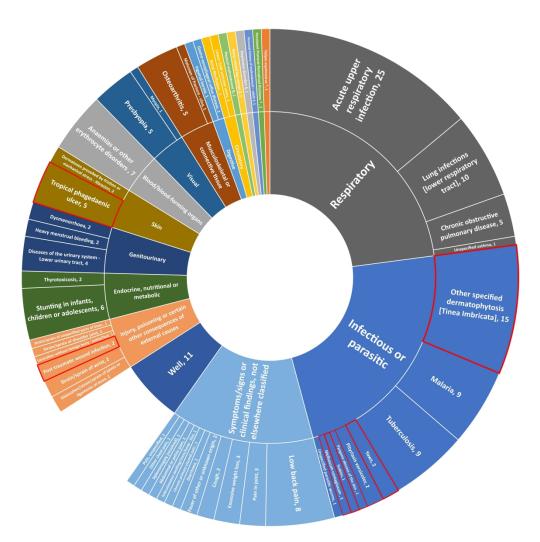


Figure 3 Clinical results of primary care assessments at Wanang. 113 Wanang villagers examined (51 females, 62 males), 168 diagnoses given (not including 11 classifications of 'well'). The proportion of each concentric circle relates to the proportion a diagnosis was given as part of the total number of diagnoses, with categories arranged clockwise high to low. The inner circle shows ICD-11 primary categories, the outer circle ICD-11 specific conditions (or ICD-11 symptoms/signs/clinical findings) with number of diagnoses given for each. Infections/parasitic conditions primarily affecting skin are outlined in red. * Developmental. † Ear/mastoid process. ‡ Factors influencing health status/contact with services. § Mental, behavioural or neurodevelopmental disorders. ¶ Sleep-wake disorders. ¶ External causes of morbidity/mortality.

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Figure 4. Phased health service introduction at Wanang. Examples of training provided: fracture management (A), off-road vacuum-stretcher evacuation (B). Wanang Aid Post, outside with a northern cassowary (*Casuarius unappendiculatus*) chick (C) and backrooms for nurse consultations (D). Examples of disease targets for proactive integrated interventions, tropical ulcer (E), yaws (F), tinea imbricata (G), scabies mite and eggs (H). Images from Madang Province in PNG (specifically: A, Baitabag; B, Nagada; C, D, E, F and H, Wanang) apart from *Sarcoptes scabiei* microscopy (H). Credit: A, D, E, F, and H, first author JM; B and G, co-author JAS; C, co-author VN.

139x130mm (300 x 300 DPI)

SUPPLEMENTARY FILE

Middleton, Colthart, Dem, *et al*. Health service needs and perspectives of a rainforest conserving community in Papua New Guinea's Ramu lowlands: a combined clinical and rapid anthropological assessment with parallel treatment of urgent cases. Submitted to *BMJ Open* 2023.

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REPORTING

Reporting checklist based on 'Appraising studies in health using rapid assessment procedures' [13]

This checklist is provided in line with the following statement in our protocol: 'The article will reference this protocol noting changes in method, and include a filled-in reporting checklist based on criteria for appraising studies in health using RAP' [4]. All changes are noted in the manuscript under the subheader 'Changes from our published protocol' in the methods section. Criteria in '_' are quoted from [13].

Criteria	Page, line number
'1. Aim (Is the aim of the study clearly described?)'	5, 124–127.
'2. Subjectivity (Are the researchers' background, prior knowledge and relationship to the community, and cultural competence clearly presented and addressed?)'	Paper: 6, 166–171; 7, 185–186; 25, 686–699. Sup. File: 3.
'3. Field research guidelines (Is there an adequate description of the field guide and the rationale and process of its development?)'	Fully detailed in published protocol, which also includes all recruitment materials, KI and FG topic guides, clinical data collection forms, pharmacy, etc.[4]. Paper: 5–6, 133–142, 161–165.
'4. Staff (Is the recruitment process and training of research assistants presented, and is it sound?) RAP studies usually use research assistants in the collection of primary data from the field. Many researchers establish specific criteria for selecting assistants and these should be communicated. Further, the training process and content should be presented.'	Detailed in published protocol. Fieldwork RAs were existing RTs and PNG nationals at in-country New Bintang Research Centre. Sup. File: 3.
'5. Data collection methods (Is the rationale for the data collection methods and types of information collected with each method clearly presented?)'	Detailed in published protocol. Paper: 6, 143–165.
'6. Selection of research sites (Is an appropriate sampling strategy for selecting the study area(s) or research site(s) described?)'	n/a – site (Wanang village) was studied as it was the community that had requested health service incorporation in their existing conservation area. See 4–5, 80–123; detailed in protocol paper.
'7. Informant selection (Is a systematic process of selecting informants used and is it adequately described?)'	Fully detailed in published protocol. Paper: 6, 145–148; 7, 199–203.
'8. Credibility (Is a strategy for assessing credibility established and presented?)'	Fully detailed in published protocol. Paper: 5, 136–137; 6, 173–174; 7, 184–190.
'9. Analysis (Is the analysis process adequately described and was it sound?)'	Fully detailed in published protocol. Paper: Fig 2; 6–7, 166–190; 7, 203–206. Sup. File: 3.
'10. Presentation (Are the findings and discussion clearly presented?)'	Paper: 8–21, 219–681. Table 1, Figs. 3 and 4. Sup. File: 3–9, Tables S1–S6.
'11. Ethics (Are ethical principles respected and is the process for informed consent described?)'	Detailed in published protocol (including recruitment scripts, consent forms etc.). Paper: 25, 701–710.

Surfaces WanangHealthNeedsSupplementary PR4

VIL I II ODS

Fieldwork team backgrounds

BSMS: JM is a research fellow in public health with a background in pre-hospital emergency care, including in remote areas, and training in disease ecology and qualitative methods. GC is a general practitioner and experienced expedition medic with training in tropical dermatology. Both had prior field experience in Melanesia (PNG; Solomon Islands). BRC: MJ and SS were research technicians (RTs) with degrees in forestry science who were brought up in rural PNG villages, had previously worked with the community, and had pre-existing skills in social studies. JP is a RT from Wanang, where he continues to live with his family.

Capacity building for PNG staff

RTs were trained in study procedures by JM, provided the protocol [4] and [19] for reference in the field, and gained practical experience working alongside JM and GC who were present during all fieldwork. BRC staff were also given a lecture on conservation and health integration projects worldwide, and a certificated 3-day course on remote care and medical evacuation (taught by JM). FD, ML, JP, SS, and RU were additionally brought to the UK from PNG in 2019 and 2022. There they received training from Brighton and Sussex Medical School and University of Sussex (e.g., project monitoring and evaluation, eDNA, ecological and health analysis) and were taken on institutional visits nationwide (e.g., Millennium Seed Bank, University of Southampton, University of Oxford, London School of Hygiene & Tropical Medicine, Kew) to build their network of collaborators and co-plan future PNG-led work.

Generating combined all-group rankings

We generated combined all-group rankings of health issues and priorities for health service introduction by adding together inversely weighting ranks from sex-age focus groups. For example, two groups ranked malaria highest, another second highest, and the remaining as fifth highest: (1st=5) + (1st=5) + (2nd=4) + (5th=1) = 15. This was the largest combined score, so malaria was reported as the overall highest ranked health issue.

RESULTS Supplementary Table S1. Primary care assessment participants.

		Medical History (n=129) (%)	Examined (n=113) (%)
Sex	Female	54 (41.9)	51 (45.1)
	Male	75 (58.1)	62 (54.9)
Age in years	0–9	50 (38.8)	45 (39.2)
	10–19	21 (16.3)	15 (13.3)
	20–29	9 (7.0)	7 (6.2)
	30–39	18 (14.0)	16 (14.2)
	40–49	10 (7.8)	9 (8.0)
	50–59	17 (13.2)	17 (15.0)
	60–69	2 (1.6)	2 (1.8)
	70–79	2 (1.6)	2 (1.8)
	Median (range)	19y (1mo-73y)	18y (1mo-73y)

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Supplementary Table S2. Diagnoses from clinical examinations in Wanang village

Specific clinical diagnoses are listed in descending order and categorised as per the International Classification of Diseases 11th Revision Version 02/2022 (ICD-11, https://icd.who.int/browse11/l-m/en), followed by the relevant ICD-11 primary code when appropriate. For example, 'Yaws' is listed as a specific condition, and as a sub-category of 'Certain infectious or parasitic diseases'. Diagnoses were recoded to ICD-11 by author JM and confirmed by author GC. Percentages are of examined males/females/all, totals are greater than n as many of those examined had multi-morbidity. In this table, preserving order of individual conditions based on their frequency only allows partial grouping by ICD-11 primary categories. However, figure 3 in the main article shows full grouping by primary categories (but not break down by sex). Five young children (all male) of the 113 individuals examined were only partially examined, due to non-compliance.

Conditions, as per International Classification of Diseases 11th Revision Version 02/2022 (ICD-11) (ICD-11 code) [authors additional information]	ICD-11 Primary category (ICD-11 code) [authors additional information]	Males N=62 (%)	Females N=51 (%)	All N=113 (%)
Acute upper respiratory infection, site unspecified (CA07.0)	Diseases of the respiratory system (ICD 12)	9 (14.5)	16 (31.4)	25 (22.1)
Other specified dermatophytosis (1F28.Y) [Tinea Imbricata]	Certain infectious or parasitic diseases (ICD 01)	11 (17.8)	4 (7.8)	15 (13.3)
Well *		5* (8.1)	6* (11.8)	11* (9.7)
Lung infections (CA4Z) [lower respiratory tract] †	Diseases of the respiratory system (ICD 12)	4 (6.5)	6 (11.8)	10 (8.8)
Malaria	Certain infectious or parasitic diseases (ICD 01)	4 (6.5)	5 (9.8)	9 (8.0)
Tuberculosis, unspecified (1B1Z) ‡	k	4 (6.5)	5 (9.8)	9 (8.0)
Low back pain (ME84.2)	Symptoms, signs or clinical findings, not elsewhere classified (ICD 21)	6 (9.7)	2 (3.9)	8 (7.1)
Anaemias or other erythrocyte disorders, unspecified (3A9Z) §	Diseases of the blood or blood-forming organs (ICD 03)	2 (3.2)	5 (9.8)	7 (6.2)
Stunting in infants, children or adolescents (5B53)	Endocrine, nutritional or metabolic diseases (ICD 05)	3 (4.8)	3 (5.9)	6 (5.3)
Tropical phagedaenic ulcer (EA40)	Diseases of the skin (ICD 14)	4 (6.5)	1 (2.0)	5 (4.4)
Osteoarthritis, unspecified (FA0Z)	Diseases of the musculoskeletal system or connective tissue (ICD 15)	2 (3.2)	3 (5.9)	5 (4.4)
Chronic obstructive pulmonary disease, unspecified (CA22.Z) ¶	Diseases of the respiratory system (ICD 12)	4 (6.5)	1 (2.0)	5 (4.4)
Presbyopia (9D00.3)	Diseases of the visual system (ICD 9)	5 (8.1)		5 (4.4)
Diseases of the urinary system, unspecified (GC2Z) - Lower urinary tract (XA34X0)	Diseases of the genitourinary system (ICD 16)	3 (4.8)	1 (2.0)	4 (3.5)
Pain in joint (ME82)	Symptoms, signs or clinical findings, not elsewhere classified (ICD 21)	2 (3.2)	1 (2.0)	3 (2.7)
Excessive weight loss (MG43.5)		1 (1.6)	2 (3.9)	3 (2.7)
Cough (MD12)			2 (3.9)	2 (1.8)
Fever of other or unknown origin (MG26)		1 (1.6)	1 (2.0)	2 (1.8)
Pityriasis versicolor (1F2D.0)	Certain infectious or parasitic diseases (ICD 01)	1 (1.6)	1 (2.0)	2 (1.8)
Yaws (1C1D) Δ			2 (3.9)	2 (1.8)
Dysmenorrhoea (GA34.3)	Diseases of the genitourinary system (ICD 16)		2 (3.9)	2 (1.8)
Heavy menstrual bleeding (GA20.50)			2 (3.9)	2 (1.8)
Thyrotoxicosis (5A02)	Endocrine, nutritional or metabolic diseases (ICD 05)	1 (1.6)	1 (2.0)	2 (1.8)
Dermatoses provoked by friction or mechanical stress (EH92) - Abrasion (XJ652)	Diseases of the skin (ICD 14)	1 (1.6)	1 (2.0)	2 (1.8)
Strain or sprain of wrist (NC54.6)	Injury, poisoning or certain other consequences of external causes	2 (3.2)		2 (1.8)
Post traumatic wound infection, not elsewhere classified (NF0A.3)	(ICD 22)	2 (3.2)		2 (1.8)
Dislocation or strain or sprain of joints or ligaments of the knee (NC93) **		2 (3.2)		2 (1.8)
Strain or sprain of other or unspecified parts of knee (NC93.7)		1 (1.6)		1 (0.9)
Strain or sprain of shoulder joint (NC13.5)		1 (1.6)		1 (0.9)
Laceration without foreign body of ankle or foot (ND12.0)		1 (1.6)		1 (0.9)

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Pain, unspecified (MG3Z)	Symptoms, signs or clinical findings, not elsewhere classified (ICD 21)	1 (1.6)		1 (0.9)
Other chest pain (MD30.1)		1 (1.6)		1 (0.9)
Chronic primary visceral pain (MG30.00)		,	1 (2.0)	1 (0.9)
Splenomegaly, not elsewhere classified (ME10.01) [resolved]		1 (1.6)		1 (0.9)
Diarrhoea (ME05.1)		1 (1.6)		1 (0.9)
Abdominal or pelvic pain (MD81)			1 (2.0)	1 (0.9)
Subcutaneous swelling, mass or lump of uncertain or unspecified nature (ME61) -			1 (2.0)	1 (0.9)
Iliac region (XA0NH8)				
Scabies (1G04) §§	Certain infectious or parasitic diseases (ICD 01)	1 (1.6)		1 (0.9)
Other and unspecified infestation by parasitic worms (1F90) ††		1 (1.6)		1 (0.9)
Molluscum contagiosum (1E76)		1 (1.6)		1 (0.9)
Pyogenic abscess of the skin (1B75.3)			1 (2.0)	1 (0.9)
Persistent Postural-Perceptual Dizziness (AB32.0)	Diseases of the ear or mastoid process (ICD 10)	1 (1.6)		1 (0.9)
Personal history of maltreatment (QE82) - adult (XT6S) [domestic]	Factors influencing health status or contact with health services (ICD 24)		1 (2.0)	1 (0.9)
Myopia (9D00.0)	Diseases of the visual system (ICD 09)	1 (1.6)		1 (0.9)
Talipes equinovarus (LB98.00)	Developmental anomalies (ICD 20)	1 (1.6)		1 (0.9)
Unspecified asthma (CA23.3)	Diseases of the respiratory system (ICD 12)	1 (1.6)		1 (0.9)
Sleep-related leg cramps (7A82)	Sleep-wake disorders (ICD 07)	1 (1.6)		1 (0.9)
Inguinal hernia (DD51) - Left (XK8G)	Diseases of the digestive system (ICD 13)	1 (1.6)		1 (0.9)
Gastro-oesophageal reflux disease (DA22)			1 (2.0)	1 (0.9)
Malunion of fracture (FB80.7) - Fracture of upper end of ulna (NC32.0)	Diseases of the musculoskeletal system or connective tissue (ICD 15)		1 (2.0)	1 (0.9)
Depressive disorders, unspecified (6A7Z)	Mental, behavioural or neurodevelopmental disorders (ICD 06)		1 (2.0)	1 (0.9)
Lower limb varicose veins, not further specified (BD74.1Z)	Diseases of the circulatory system (ICD 11)		1 (2.0)	1 (0.9)
Atrial fibrillation (BC81.3)		1 (1.6)		1 (0.9)
Physical maltreatment (PJ20) Ⅱ	External causes of morbidity or mortality (ICD 23)	1 (1.6)		1 (0.9)
Totals of diagnosed morbidities *		92	76	168

^{*&#}x27;Well' classifications (marked in green) were not included in the final calculations of total diagnoses of morbidities. The following individual diagnoses were classified by the examining primary care clinician (GC) as "possible" or "suspected": † Lung infections [lower respiratory tract], 3 of 10; ‡ Tuberculosis, unspecified, 8 of 9; § Anaemias or other erythrocyte disorders, unspecified, 5 of 7; | Stunting in infants, children or adolescents, 3 of 6; ¶ Chronic obstructive pulmonary disease, unspecified, 2 of 5; Δ Yaws, 1 of 2; ** Dislocation or strain or sprain of joints or ligaments of knee, 1 of 2; †† Other and unspecified parasitic worms, 1 of 1; §§ Scabies, 1 of 1; III Physical maltreatment, 1 of 1.

Table S3. Ethnoclassification taxonomy of "Malaria" (1st in combined group rankings).

Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians at the time.

	"Malaria" (Tok Pisin	and English) (all)					
Who			Old "It occurs a lot in young of the time it's old people	g school chil		Informant [KI]) ● "Most
When	• "malaria can occur a time. In the dry season season – same" (3<40	, still there are mosq	-	"Mostly in see more i		ne rainy sea . So if it rain (I)	ason as more, you
Cause			Mosquitos [local name:	"nagi"]			
	Animal blood	Mosquito eggs	Sleeping in the		Env	ironment	
	"They might bite our	"mosquito's eggs	open ● "Sleeping in the	Bushy		vampy	Rubbish
	skin in this way the skin has the same	will stay inside them and that	open" (♀<40y	"It all	"Swa		"Tins and
	blood they take it	causes this"	FG) • "Not	grasses ne their hous		s are a lina	plastics create a
	from pigs or dogs or	(♀<40y FG)	having a mosquito	(KI)	place	0	breeding
	whatever and come		net" (♀≥40y FG)			uitos"	place for
	back and put it into men's skin."		"maybe they don't sleep in a		(KI)		mosquitoes"
	(♂<40y FG)		mosquito net" (KI)				(KI)
Signs and	• High fever • shiv	ers • cold skin • ye	ellow skin • strong head	pain • fee	l weak • ca	nnot walk	dizziness •
symptoms			niting ● joint pain ● cou				
	FG) ● "fever, shivers, very weak" (♂<40y FC they feel dizzy, dizzing signs." (KI) ● Strong I malaria) ● Cough (P 7 feeling cold, fever (P 8	headache, cough, co G) • "cold sickness" ess, and they tend to head pain, very high y, confirmed malaria	the afternoon and mornin old skin" (♂≥40y FG) • "t (♀≥40y FG) • "Chill, wh vomit regularlywe susp fever, joint pain, vomiting a) • Head pain, high fever a) • Can't walk properly	they feel co hen they are pect that the g, very weak r, weak (P 1 (P 4y, confi	ld, their hair e feeling chi ey have mala k (Parent [P y, confirme irmed malar	rs will be stall, high feve aria, by look of 13y with d malaria) •	inding on end, r, sometimes ing at those h confirmed b Head pain,
Treatment	Nothing/rest	Pharmacy	Steam with medic		Hospital	Comfort	t Private
	• "In this	drugs					
	community they	J	from the forest		• "the	"Rock	health
	community they don't go look for	<u> </u>			• "the hospital will treat"	"Rock cradle them	
	community they don't go look for treatment they are	<u> </u>			hospital	cradle them allot"	care staff
	don't go look for treatment they are sick they just stay in	<u> </u>			hospital will treat" (♀<40y FG)	cradle them allot" (♀<40y	care staff Private doctor (P 7y,
	don't go look for treatment they are sick they just stay in their bed rest until	Amoxicillin Paracetamol Chloroquine		Citrus fruit	hospital will treat" (♀<40y FG) • "when	cradle them allot"	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good,	Amoxicillin Paracetamol Chloroquine	Guava Grass Grass	Citrus fruits	hospital will treat" (\$\times 40y\$ FG) • "when they get	cradle them allot" (♀<40y	care staff Private doctor (P 7y,
	don't go look for treatment they are sick they just stay in their bed rest until	Amoxicillin Paracetamol Chloroquine "When you	Papaya Grass Grass Grass Grass sme	Citrus fruits	hospital will treat" (♀<40y FG) • "when	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill	Amoxicillin Paracetamol Chloroquine	Guava Grass Grass	Citrus fruits	hospital will treat" (\$\times 40y\$ FG) • "when they get worse they call the	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the	Chloroquine "When you go to town or hospital they take them, and	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up,	Citrus fruits ell, them, to	hospital will treat" (\$\times < 40\$y FG) • "when they get worse they call the Binatang	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their	Chloroquine "When you go to town or hospital they take them, and BRC sometimes	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • "	Citrus fruits ell, them, to and "We use	hospital will treat" (\$\times < 40y\$ FG) "when they get worse they call the Binatang people so	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the	Chloroquine "When you go to town or hospital they take them, and BRC sometimes sends supplies	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water	Citrus fruits ell, them, o to and "We use - cover	hospital will treat" (\$\times < 40\$y FG) • "when they get worse they call the Binatang	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just	Chloroquine • "When you go to town or hospital they take them, and BRC sometimes sends supplies here"	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀≥40y FG) • 'steam - make hot water them up with a bed shee	Citrus fruits ell, them, o to and "We use - cover et, find a tick:	hospital will treat" (\$\times < 40\$y FG) • "when they get worse they call the Binatang people so when they have the trip	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the	Chloroquine • "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (3<40y FG) • "Panadol,	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea	Citrus fruits ell, them, o to and "We use - cover et, find a tick: eves,	hospital will treat" (♀<40y FG) • "when they get worse they call the Binatang people so when they have the trip coming up	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like	• "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (5<40y FG) • "Panadol, bought from	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave	Citrus fruits ell, them, o to and "We use - cover et, find a tick: ess,	hospital will treat" (\$\square\$<40y FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the	• "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (♂<40y FG) • "Panadol, bought from pharmacy" (P	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Only	Citrus fruits ell, them, o to and "We use - cover et, find a tick: tick: tick: tick: tick: tyes, es, dy a few	hospital will treat" (♀<40y FG) • "when they get worse they call the Binatang people so when they have the trip coming up	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	• "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (5<40y FG) • "Panadol, bought from	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave	Citrus fruits ell, them, to to and "We use - cover et, find a tick: tives, es, by a few to know to how to	hospital will treat" (\$\times < 40\$y FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	Paracctammol • "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (♂<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol,	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Only people in the community how to use it - he knows do that. Vines no dring the community was also should be supposed to the community how to use it - he knows do that. Vines no dring the community how to use it - he knows do that.	Citrus fruits ell, them, to to and "We use cover et, find a tick:	hospital will treat" (\$\times < 40 y\$ FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the hospital."	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	Paracctiammol • "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (♂<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol, Chloroquine,	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Onl people in the community how to use it - he knows do that. Vines no drin only steam. When finish	Citrus fruits ell, them, o to and "We use - cover et, find a tick: tives, es, by a few w know is how to aks no, and, we	hospital will treat" (\$\times < 40\$y FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	• "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (5<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol, Chloroquine, Amoxicillin"	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Only people in the community how to use it - he knows do that. Vines no drin only steam. When finish can wash them using co	Citrus fruits ell, them, to to and "We use - cover et, find a tick: tives, es, ty a few ty know to aks no, ned, we ald	hospital will treat" (\$\times < 40 y\$ FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the hospital."	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	Paracctiammol • "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (♂<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol, Chloroquine,	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • 'steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Onl people in the community how to use it - he knows do that. Vines no drin only steam. When finish	Citrus fruits ell, them, to and "We use - cover et, find a tick: tves, es, ty a few to how to held we ded We tend	hospital will treat" (\$\times < 40 y\$ FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the hospital."	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	• "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (5<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol, Chloroquine, Amoxicillin"	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Onl people in the community how to use it - he knows do that. Vines no drin only steam. When finish can wash them using cowater" (♂<40y FG) • "to use medicine from the - like tree leaves, papaya	Citrus fruits ell, them, to and "We use - cover et, find a tick: ves, es, ly a few y know how to nks no, ned, we old We tend e forest a You	hospital will treat" (\$\times < 40 y\$ FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the hospital."	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed
	don't go look for treatment they are sick they just stay in their bed rest until they feel good, better maybe two or three weeks after they become ill again, because the bacteria is in their body and it's not dead." (KI) • "A lot of the time we just stay here, and the illness goes and, like it finishes on its	• "When you go to town or hospital they take them, and BRC sometimes sends supplies here" (5<40y FG) • "Panadol, bought from pharmacy" (P 4y, confirmed malaria) • "Panadol, Chloroquine, Amoxicillin"	• "We take grass sme guava, citrus fruits, boil heat water really hot, go bedside, cover them up, steam" (♀ ≥40y FG) • steam - make hot water them up with a bed shee large pot, stir it with a st Papaya leaves, grass lea grass smell, guava leave ginger, citrus fruits. Onl people in the community how to use it - he knows do that. Vines no drin only steam. When finish can wash them using co water" (♂<40y FG) • "to use medicine from the	cliffus fruits ell, them, o to and "We use - cover et, find a tick: eyes, es, ey a few y know to hks no, ned, we old We tend e forest a You these	hospital will treat" (\$\times < 40 y\$ FG) • "when they get worse they call the Binatang people so when they have the trip coming up they will just go down to the hospital."	cradle them allot" (♀<40y	care staff Private doctor (P 7y, confirmed

^{*}Similar community plant-usage for "malaria" has been reported elsewhere in PNG. For a useful summary (though one that does not evaluate effectiveness) see: WHO. Medicinal plants of Papua New Guinea. Manila: World Health Organization Western Pacific Region 2009.

$Surfaces_WanangHealthNeedsSupplementary_PR4$

Table S4. Ethnoclassification taxonomy of "Sotwin" (2nd in combined group rankings)

Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians.

Names	"Sotwin" (all)	a hovered s-4b.			"Umbang aul" (Local language)	
	Tok Pisin '1.out of breath, to gasp for breath, to Symptomatic labellin were likely sometimes describing experie asthma, particularly when no individual c available. • "I don't know what – is it TB	ndition and symptonces of other cond inical diagnosis ha	om (see left), people itions beyond ad been previously		language) l0y FG)	
	pant; 2. to that's hard to know If we have medical patrol team they go to the Wanan					
	asthma' have TB or, just a cough''' (Key Informat [23] complained of "Sotwin", diagnosed on as					
Who	"Everybody/Everyone" • "Everybody/Everyone" Focus Groups [FG]: ♀<40y; ♂		ecially children like kids, but	Middle-ag	ged people ge people	
	≥40y; ∂<40y)* • "asthma is covering all the living peop	le young one	is OK maybe 5	"middle-ag	ed people	
	in Wanang, from the kids up to the old people." (KI) • "cold/cough, "sotwin", they are very widespread inside		then people up to s and above	and old-ag Not many y		
	Wanang not just older men or women." (KI)		m are affected coughing." (KI)	people." (k	(I)	
When		the time		OKD.		
Cause	• "It's not seasonal - any time" (♂≥40y FG) • "No, all y Smoking Chewing Meat, fish, cooking	Sex with		Rubbish	The sur	
	• (3\ge 40y Betel nut • "Eating bloody meat	women	"I'm sitting	and dust	(♀<40y	
	FG) • "think ($\eth \ge 40$ y Fish, like blood so, you do the cause is FG) dry it" ($\eth \ge 40$ y FG)	n't • "a woman comes and.		" If the house is	FG)	
	smoking So • "you cook with fish and		h round	dirty and		
	most people has the smell of fish and y don't wash it properly and	• •	ill behind and use the	you sleep with		
	place most of use it as a water container	or "sotwin" to		rubbish,		
	them are water pot for drinking, this smokers" can cause "sotwin". Fish.		where you were	dust, then you will		
	(KI) if you don't dry it properly	\ - ·	·	get"		
	and you cook it and some			(♂<40y		
	eats it, it can cause "sotwin (♀<40y FG) • "the	i"" leg Go w them"	ith	FG)		
	women cook, give to yo and you eat it" (8<40y FC		()			
Signs and	• Heavy breathing • fast breathing • difficulty dur		cise • coughing • "s	sotwin" ● w	eakness	
symptoms	• "When you walk up and down the mountain, you migh					
	breathing very heavily then we would know, he has "sotv as well when you go up a mountain you will need frequently will sit down, walk around and just rest close to [the	ient rests" (♂≥40y	FG) • "The man mi	ght be coug	hing a lot.	
	like, your breath will become locked and you will faint" (When they walk around you will see them coughing." (K)	♂<40y FG) • "Th	ey tend to cough pub	licly, like op	enly.	
	cough cough cough, suddenly it will come like very stressorwin, described symptom as cough (55y PT, diagnosed					
	diagnosed on assessment with URTI) • has no strength (3					
	(P of 11months, diagnosed on assessment with LRTI)					
Treatment	Medicine from the forest	Pharmac Septrin		tment lo people	Drink cold	
	Banana drink Papaya leaf Vine sap	(51y PT,	(55y treat thi	s illness?]	water	
	• "banana in a cup, strain it, give it to the child. You can heal it in the village (unlike malaria which is hard - for the		PT, "No. The diagno live with	ey just h the kus,	(♂<40y FG)	
	you should go straight to the hospital). Papaya leaf" (\$\frac{1}{2} \le 4	0y assessme	sed on cough."		10)	
	FG) • "You get some sap from a vine, just sap from a vine cut it [local name: "bamul"]" (♂<40y FG) • "it doesn't	iit witti		d "Sotwin"		
	have this kind of strong medicine from the forest. We have	LRTI and COPD)	ment but had with treatment	nad no nt (P of 2y,		
	tried many times when "sotwin" has occurred and you ta	ke2)	LRTI, diagnos	ed on		
	these kinds of medicines and just drink them, it will only help you for a short time a day and tomorrow or the da	v		ent with LRTI; 48y		
	after "sotwin" will occur again, OK some "sotwin" does			gnosed on		
	go on for very long, it can go away and stop, and some people if "sotwin" has already taken hold of them, they w	zill		ent with		
	try all kinds of medicine but it won't be enough, the		e06 46y	50y PT; PT).		
	"sotwin" will continue all the way until you become old.			,		
	and they die" (♂≥40y FG) • Bush rope (cut the rope and drink the white sap) (39y PT diagnosed on assessment wi	th				
	LRTI)					

texts without quotation marks are from patient histories summarised by PNG research technicians.

Names	"Susu cancer"	"cancer bodi insait"	"Sik bilong ol mama"
raines	Breast cancer (♂≥40y	Cancers inside body (♂≥40)	
	Focus group [FG])	• ,	
Who		We don't know	"Mothers, older women,
	"Now a lot of us living here have cancer to the hospital in order to get medicin		
	"you have cancer" (\$\geq 240\text{y FG})	e or sometimg the doctors.	they will say (+=10) 1 3)
When	"It arrived in	2014 in the communities aro	ound here" (♀<40y FG)
Cause		leat and Fish	Smoking Betelnut
	$($ \$\text{\$\sigma}\$<40y FG $)$ "Eating meat or the	nat kind of thing you don't	"This cancer that tends "OK chew a lot
		erly sometimes this can s or cancer inside, it's like,	to be with a cough of betelnut sometimes smoke a lot then cancer will
		ifish and you take it and you	
	boil it and you eat		(♂≥40y FG) (♂≥40y FG)
Signs and	"We don't know ourselves we fin		Cough Patient is red
symptoms	"Now a lot of us living here have cancer ourselves, we don't know if we have can		"it tends to occur with a cough and illness blood" (♀≥40y FG)
	we go to the hospital in order to get med		inside it tends to occur
	the doctors check us or when they check		again inside" (♂≥40y
	will say "you have cancer" so we find		FG)
	(∂≥40y FG)	X 1 (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(O :40, FO)
Treatment	Hospital treatment not always succe	Only the hospital will treat" ((¥<40y FG) t for referrals, hospital attendance to delayed
	particularly if patients flee treatm		is wife. She – she got the cervical cancer, she got
	"OK cancer if it occurs, there is no way	2	r two years if Wanang have a small haus sik
	this, sometimes we go to the doctor and		get a report and then move to the general hospita
	doctor is able to cure the cancer, it will		sy to get treatment. But because of no haus sik
	finish suppose we tell them about our and we go and stay in the hospital, it's li		. herself she think that she is OK but the sickness, so we all never know what is with her, so after,
	cancer can be stopped but if we are afrai		tage – stage 4, then we all surprised then we took
	the injection or something and they get t		and go to the x-ray and they said "oh, cervical
	needle out and we run away, sometimes		e in 50-50" so we try two hospitals here in
	cancer will not stop and the cancer will s		nnot work as they said no medicine, we move her
	on the body and after you become an old man you can die from this" (♂≥40y F		o Kundiawa General Hospital, and we went there ay. So, that's happened to like my mother and his
	man you can die nom ans (0=40y 1	wife" (Key Infor	

Table S6. Ethnoclassification taxonomy of "Grile" (Tinea imbricata) (4th in combined group rankings). Quotes in roman are translated from Tok Pisin (dual transcripts retained), quotes in italics were spoken as written. Attributed texts without quotation marks are from patient histories summarised by PNG research technicians.

Names	"Grile" (Tok Pisin: ♂≥40y, ♀<40 ♂<40y Focus Groups [FG]		<i>"Kavnam"</i> (Loc ∂≥40y, ∂<4			"crocodile 10y, ♂<40	e" (Tok Pisin y FGs)	
Who	Everyone, particularly infants &	& children	Children	1 Y	oung (Older wor	nen, people	
W IIO	• "Everyone, all ages" (♂≥40y FC		• "Most of the		men		iding it	
	to occur in children, also people lik		children have th	is "Gr	ile "T	here's a lo	ot of tinea.	
	maybe some older men [and] wo	disease" (KI)						
	well, little girls too. Most of the tim	• "[Q] You say						
	occurs in babies, in younger and oldoccasionally" (♂<40y FG) • "oldes	of the children l [have Grile], ho				of us sitting ave it some		
	middle aged people and some child		many children a	,		ople are h		
	Maybe from small to older people"		have in the scho	•		-	e it" (♀≥40y	
	Informant [KI])	•	[A] I have 186.	"(KI)	FC	\vec{i})	•	
When	Anytime ◆ "It doesn't have season."	s."(KI) ● "Ye	ear to year. Mainly	y in the rain" (3<40y FG) • °	"Anytime"	" (♂≥40y FG	
Cause	Wet clothes		aminated rivers			_	lothes [and	
			river, like bad sw		differing bo			
			lean, not flowing.		• "friend of y			
			hing upstream fro catch tinea." (KI)		sleeps with ever in bed and if l			
			, ,	•				
			the upstream and a man athing downstream, then		touch him while sleeping, still I will get tinea in this case, both of our			
				_		bodies touch so it can move across,		
						but if my body is not the right kind to		
			ds of water, some		get tinea from			
			(♂≥40y FG) • "it		to and if my			
	E .		something upstreament something you w		as his, I will c FG) ● "If a m			
			sometining you w ney use river for w	_	you use some			
			and then the clot	_	spread to you	_		
		e sunny period the fast-		they have tinea in them, you wear				
Signs and	cause this" (♂<40y FG) • flow	come small algae grows		your clothes, you will get it."				
			mp into those riversthose (d			♂<40y FG) • transmitted from		
		bacteria, so they	•					
	clothes" (KI) Grile." (KI) other boys (patient histories) • Skin like crocodile • scratching • pain							
•	• "Skin like crocodile. You might					voman als	o, the skin	
symptoms	• "Skin like crocodile. You might get it on your arm or leg A man with tinea will scratch, a woman also, the skin will be painful" (♂≥40y FG) • "They will be scratching it's like all over the body, that's what this tinea is" (♂<40y							
	will be painful (0240y FG) • 11	icy will be ser	atching it's like	an over the bo	ouy, mai s wna	at tims times	a 1s'' (♂<40y	
	FG) • Some people are hiding it so	you can't see	it" (♀≥40y FG) •	"Itchy all the	time and they	tend to sc	ratch it all	
	FG) ● Some people are hiding it so the time. [Q]: So they're itching, the	you can't see is could be of	it" ($\stackrel{>}{\hookrightarrow}$ 40y FG) • her conditions so	"Itchy all the how do we kno	time and they	tend to sc	ratch it all	
	FG) • Some people are hiding it so the time. [Q]: So they're itching, th go on their skin by looking at the	you can't see is could be oth m you can see	it" ($\mathcal{L} \geq 40 \text{y FG}$) ther conditions so that they have $\mathcal{L} = 40 \text{y}$	• "Itchy all the how do we kno rile." (KI)	time and they w it's Grile? [tend to sc [A]: Itchy	ratch it all and it just	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, th go on their skin by looking at the "we are not able to cure we ma	you can't see is could be ou m you can see ike forest med	it" ($\mathcal{L} \geq 40 \text{y FG}$) ther conditions so that they have $\mathcal{L} = 40 \text{y}$	"Itchy all the how do we kno rile." (KI) cdicines [but].	time and they ow it's Grile? [tend to sc [A]: Itchy	ratch it all and it just	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, th go on their skin by looking at the "we are not able to cure we ma Traditional treat	you can't see his could be ou m you can see ke forest med ments	it" ($\bigcirc \ge 40y \text{ FG}$) • ther conditions so that they have Grilcine, we buy mo	• "Itchy all the how do we kno rile." (KI) edicines [but]. Hospital	time and they w it's Grile? [it just come //Pharmacy	tend to sc [A]: Itchy es back."	ratch it all and it just (♂<40y FG) Effectively	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, th go on their skin by looking at the "we are not able to cure we ma Traditional treat Plant-based ointments from the f	you can't see is could be ou m you can see the forest med ments forest Place	it" (♀≥40y FG) • ther conditions so that they have Go licine, we buy mo ing skin Grib	• "Itchy all the how do we kno rile." (KI) edicines [but]. Hospital.	time and they ow it's Grile? [it just come /Pharmacy Grile table	tend to sc [A]: Itchy es back."	ratch it all and it just (3<40y FG) Effectively.	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, the go on their skin by looking at the "we are not able to cure we ma Traditional treat Plant-based ointments from the f Lime, Seeds of "Mo	you can't see is could be out m you can see ike forest med ments forest Placi der" insid	it" (♀≥40y FG) • ther conditions so that they have Gr dicine, we buy mo ting skin Gribbe Gribbe Gribbe	• "Itchy all the how do we kno rile." (KI) edicines [but]. Hospital. e cream naftate]	time and they w it's Grile? [it just come //Pharmacy Grile table [Terbinafin	tend to sc [A]: Itchy es back." et [e]	ratch it all and it just (3<40y FG) Effectively No treatment	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, the go on their skin by looking at the "we are not able to cure we ma Traditional treat Plant-based ointments from the f Lime, Seeds of "Mo	you can't see is could be out m you can see ke forest med ments forest Placi der" insid baya bana	it" (♀≥40y FG) • ther conditions so that they have Gr dicine, we buy mo ting skin te ting skin	• "Itchy all the how do we kno rile." (KI) edicines [but]. Hospital.	time and they w it's Grile? [it just come /Pharmacy Grile table [Terbinafin "Occasio If a man ha	tend to sc [A]: Itchy es back." et ee] nally.	ratch it all and it just (3<40y FG) Effectively No	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, the go on their skin by looking at the "we are not able to cure we ma Traditional treat Plant-based ointments from the f Lime, Seeds of "Mo pepper, "sigwal" [Pa]	you can't see is could be on m you can see ke forest med ments forest Placi der" insid baya bana od] "Med use	it" (♀≥40y FG) • ther conditions so that they have Gr licine, we buy mo ting skin te tina tree dicine I the like of the like	• "Itchy all the how do we know rile." (KI) edicines [but]. Hospital. e cream naftate] n the town gets medicine ointment	time and they w it's Grile? [it just come //Pharmacy Grile table [Terbinafin	tend to sc [A]: Itchy es back." et tel nally. s nea all	ratch it all and it just (\$\infty\$<40y FG) Effectively No treatment "There is no treatment. Looking at	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, the go on their skin by looking at the "we are not able to cure we ma Traditional treat Plant-based ointments from the Lime, Seeds of "Mo pepper, "sigwal" [Paj and tree blud paste • "take kambang [lime powder use	you can't see is could be of m you can see ike forest med ments forest Placi der" insid baya bana od] "Meu use d remo	it" (Ç≥40y FG) • ther conditions so that they have Gi licine, we buy ma ting skin te tina tree dicine I the conditions so that they have Gi lice to se the like to the like t	• "Itchy all the how do we know rile." (KI) edicines [but]. Hospital e cream maftate] in the town gets medicine ointment d medicine,	time and they w it's Grile? [it just come //Pharmacy Grile table [Terbinafin	tend to sc [A]: Itchy es back." et ee] nally. s nea all dy, all	ratch it all and it just (3<40y FG) Effectively No treatment "There is no treatment. Looking at them I	
Treatment	FG) • Some people are hiding it so the time. [Q]: So they're itching, the go on their skin by looking at the "we are not able to cure we ma Traditional treat Plant-based ointments from the Lime, Seeds of "Mo pepper, "sigwal" [Paŋ and tree tree blo bud paste • "take kambang [lime powder use when chewing betelnut], daka [pep	you can't see is could be on m you can see ike forest med ments forest Placi der" insid baya bana od] "Med use d remo per from	it" (♀≥40y FG) • ther conditions so that they have Gr licine, we buy mo ting skin te tina tree didicine I to ne g like c tives tinea people,	• "Itchy all the how do we know rile." (KI) edicines [but]. Hospital. e cream naftate] n the town gets medicine ointment d medicine, st rub in, and	time and they w it's Grile? [it just come //Pharmacy Grile table [Terbinatin	tend to sc [A]: Itchy es back." et tell nally. s nea all dy, all ne	ratch it all and it just (3<40y FG) Effectively No treatment "There is no treatment. Looking at them I always	
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This checklist is provided in line with the following statement in our protocol: 'The article will reference this protocol noting changes in method, and include a filled-in reporting checklist based on criteria for appraising studies in health using RAP' [4]. All changes are noted in the manuscript under the subheader 'Changes from our published protocol' in the methods section. Criteria in '_' are quoted from [13].

Criteria	Page, line number
'1. Aim (Is the aim of the study clearly described?)'	5, 124–127.
'2. Subjectivity (Are the researchers' background, prior knowledge and relationship to the community, and cultural competence clearly presented and addressed?)'	Paper: 6, 166–171; 7, 185–186; 25, 686–699. Sup. File: 3.
'3. Field research guidelines (Is there an adequate description of the field guide and the rationale and process of its development?)'	Fully detailed in published protocol, which also includes all recruitment materials, KI and FG topic guides, clinical data collection forms, pharmacy, etc.[4]. Paper: 5–6, 133–142, 161–165.
'4. Staff (Is the recruitment process and training of research assistants presented, and is it sound?) RAP studies usually use research assistants in the collection of primary data from the field. Many researchers establish specific criteria for selecting assistants and these should be communicated. Further, the training process and content should be presented.'	Detailed in published protocol. Fieldwork RAs were existing RTs and PNG nationals at in-country New Bintang Research Centre. Sup. File: 3.
'5. Data collection methods (Is the rationale for the data collection methods and types of information collected with each method clearly presented?)'	Detailed in published protocol. Paper: 6, 143–165.
'6. Selection of research sites (Is an appropriate sampling strategy for selecting the study area(s) or research site(s) described?)'	n/a – site (Wanang village) was studied as it was the community that had requested health service incorporation in their existing conservation area. See 4–5, 80–123; detailed in protocol paper.
'7. Informant selection (Is a systematic process of selecting informants used and is it adequately described?)' (8. Credibility (Is a strategy for assessing and ibility established)	Fully detailed in published protocol. Paper: 6, 145–148; 7, 199–203.
'8. Credibility (Is a strategy for assessing credibility established and presented?)'	Fully detailed in published protocol. Paper: 5, 136–137; 6, 173–174; 7, 184–190.
'9. Analysis (Is the analysis process adequately described and was it sound?)'	Fully detailed in published protocol. Paper: Fig 2; 6–7, 166–190; 7, 203–206. Sup. File: 3.
'10. Presentation (Are the findings and discussion clearly presented?)'	Paper: 8–21, 219–681. Table 1, Figs. 3 and 4. Sup. File: 3–9, Tables S1–S6.
'11. Ethics (Are ethical principles respected and is the process for informed consent described?)'	Detailed in published protocol (including recruitment scripts, consent forms etc.). Paper: 25, 701–710.

Surfaces WanangHealthNeeds STROBE PR4

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page & line
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 1–4; 2, 37–38
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2, 40–56
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4–5, 72–130. Additionally, extensive wider background and discussion of methodological rationale given in
			published protocol paper, relevant section sign posted in start of this paper (4; 77–79: 'Here we outline site-specific context, biodiversity and health issues in PNG and our methodological rationale are discussed in detai in our published protocol.[4]')
Objectives	3	State specific objectives, including	2, 35–36; 5, 124–130.
		any prespecified hypotheses	
Methods			
Study design	4	Present key elements of study design early in the paper	4, 75–76; 5–6, 132–142; Figure 2 methodological flowchart.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Description of setting and location: 4–5, 80–123. Periods of recruitment and data collection 5, 134; 6, 143–145. Exposure and follow-up n/a.
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Described extensively in published protocol paper. In manuscript: 6, 145–148; 7, 199–203. Follow up n/a.
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a, not a matched study.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6–7, 159–165, 172–182. Detailed in published protocol paper, and its supplementary file.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 143–165; Detailed in published protocol paper, and its supplementary file. Study consisted of one community, with assessment methods uniform across group.
Bias		- 1	

Surfaces WanangHealthNeeds STROBE PR4

		potential sources of bias	Surfaces_wanangreammveeds_51KOBL_1K
Study size	10	Explain how the study size was arrived at	Paper: 6, 145–148; 7, 199–200. Protocol paper, Table 1'Study cohort and justification of participant numbers and composition'.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Paper: 6, 171–173; 7, 203–206; table 2. Paper's Supplementary File: 3, 'Generating combined all-group rankings'
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Only basic descriptive statistics reported: 6, 171–173; Paper's Supplementary File: 3, 'Generating combined all-group rankings'. (Note: See other attached reporting checklist r RAP studies, which covers wider methods used).
		(b) Describe any methods used to examine subgroups and interactions	6–7, 176–178
		(c) Explain how missing data were addressed	8, 233–235
		(d) If applicable, explain how loss to follow-up was addressed	n/a
		(\underline{e}) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8, 221–227; Figure 2.
		(b) Give reasons for non- participation at each stage	6, 146–147; 7, 200–203.
Descriptive data	14*	(c) Consider use of a flow diagram (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Figure 2 4, 81–93; 8, 221–230; Figure 2 Paper's supplementary file, Table S1
		(b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8, 233–235; paper's supplementary File, Table S2.
Outcome data	15*	Report numbers of outcome events or summary measures over time	n/a
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were	Our main results are not of this type as our study is a combined clinical and rapid anthropological assessment. Main results are reported: 8–16, 236–466; Table 1; Figure 3; Supplementary file, Table S2–S6.

			Surfaces WanangHealthNeeds STROBE PR4
		adjusted for and why they were	
		included	See other attached reporting checklist re RAP
			studies for more details.
		(b) Report category boundaries	n/a
		when continuous variables were	
		categorized	
		(c) If relevant, consider translating	n/a
		estimates of relative risk into	
		absolute risk for a meaningful time	
		period	
Other analyses	17	Report other analyses done—eg	See answer to 16a above.
		analyses of subgroups and	
		interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with	16, 468–490.
		reference to study objectives	
Limitations	19	Discuss limitations of the study,	3, 60-71; 16-17, 491-535; discussed in detail
		taking into account sources of	in our published protocol paper, with
		potential bias or imprecision.	signposting in this manuscript 17, 501-503
		Discuss both direction and	
		magnitude of any potential bias	
Interpretation	20	Give a cautious overall	18–21, 536–664
		interpretation of results considering	
		objectives, limitations, multiplicity	
		of analyses, results from similar	
		studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external	18, 536–578
		validity) of the study results	
Other information			7
Funding	22	Give the source of funding and the	26, 728–729
		role of the funders for the present	
		study and, if applicable, for the	
		original study on which the present	
		article is based	

^{*}Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.