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WITH-NESSING BACTERIA

ABSTRACT

This article addresses more-than-humans in ethnography by focusing on embodied encounters during fieldwork with the help of concepts such as relationality, being with, and with-nessing microbes. Through an ethnographic study of a diarrhoea vaccine trial in West Africa, we discuss how the more-than-human body is diffracted in clinical trial practices and how those diffractions are traced by social scientists. In some research contexts, diarrhoea-causing microbes are inevitable companions during fieldwork, creating bodily consequences and novel modes of relating to humans and nonhumans. Here, paying attention to our own experiences of co-existence helped us to ask more nuanced questions about the many ways microbes are known. When attuned to our own relationalities with microbes, we could see the open-ended, pluralistic orientation to relationality with the more-than-human and the body multiple in biomedicine.

INTRODUCTION

This article discusses more-than-human ethnographic research by revisiting our earlier research project (Huttunen and Oinas 2024). We trace the ways our own bodies mattered in how we observed and analysed the different ways medical scientists imagine and enact the human immune system and the contours of the body. This more-than-human analysis is based on a three-year qualitative study in which we followed a pharmaceutical trial testing a diarrhoea vaccine in a coastal village in Benin, Western Africa. The body lies at the centre of our analysis, referring to both lived everyday experiences during the project, and the bodies that emerge or materialise in the design, conduct, and communication of science to diverse audiences.

By revisiting our earlier analysis of these diverse approaches to the body (Huttunen and Oinas 2024), we aim in this article to engage with how our embodied encounters with microbes have informed our analytical practice. Our previous article examined the diverse influences that constitute the registers through which medical professionals conceptualise the body (Huttunen and Oinas 2024). Here, we suggest that the dynamic presence and actions of more-than-humans are important aspects of research at large, and, furthermore, that both social scientists and researchers in the medical sciences use a wide plethora of tools for understanding, living with, and depicting human-more-than-human entanglements. In our earlier study (Huttunen and Oinas 2024), we showed, using empirical data, that the generalised notion of 'Western medicine' is a bundle of diversities if one takes a closer look at what kinds of meanings are attached to the body in the practice of a vaccine trial. The key aim of our earlier analysis was to show that, even within one particularly situated yet 'global' clinical trial, there are a variety of ways medical experts seem to understand the body. In this article, we revisit our previous work (Huttunen

and Oinas 2024) and explore the ways in which our own embodied experiences informed the ways we know the body.

Our major argument in this paper is that we may not have been able to grasp the nuances of the diversity in ideas about the body were we not ourselves—as social scientists—exposed and attuned to the experience of an often painful co-existence with bacteria and various other critters whilst doing fieldwork and afterwards. Our methodological argument here is thus that when doing fieldwork, one is not only uncomfortably attuned to bacteria, but such experiences can and need to be taken seriously as more-than-human encounters that enrich the analytical work.

This article joins the strand of social scientific, especially anthropological research on human-microbial entanglements (see, for example, Helmreich 2009; Hird 2009; Hinchliffe et al. 2016; Wolf-Meyer 2017; Roy 2018; Kirksey 2019; Lorimer 2020; Brives et al. 2021; Brives 2025), to understand the diverse ways microbes are known and engaged with, and how they transform social worlds. Whilst some medical anthropologists have critiqued the way 'Western medicine' operates with an idea of one, universal body (Lock and Nguyen 2010; Scheper-Hughes and Lock 1987), there is also a multidisciplinary social science discussion that argues that biomedicine imagines more than one body on different scales (Wolf-Meyer 2017). Indeed, there are vast differences in practice and theory depending upon the field of specialisation, the level of expertise, whether what is studied is medical theory or practice, along with where and when such studies take place (Berg and Mol 1998; Mol 2002; Oinas 2019).

The assumption that medicine operates with an idea of the body as a homogeneous, universal entity with clear contours, especially in terms of the presence of other 'critters' within and around the human body, is challenged here. We do so through ethnographic observations and a detailed analysis of the different ways the body is imagined and done in specific practices of medicine, as well as in specific locations, cultures, and moments. 'Western medicine' and its constitutive ideas, whilst globally practiced and diversely criticised, critiqued, and deconstructed (e.g., Hokkanen and Kananoja 2017) is always done somewhere, by specifically situated medical experts.

The vaccine trial we studied here is international, consisting of Finnish-Swedish-US scientific collaboration, although the key activities were performed by Finnish staff and researchers. In one sense, we have studied a Finnish medical scientific understanding of the body. At the same time, our object of analysis may be better contextualised precisely within international vaccine research and global health (see Huttunen 2024). It is impossible to distinguish in our analysis where precisely we focus on a Finnish medical understanding of the body, and where our focus lies more globally. However, it is important to underscore the presence of these scales. Elsewhere, we have discussed Finnish understandings of being in relations with microbes, focusing on lay people, the research subjects of this same trial (Huttunen et al. 2021).

While doing fieldwork, our bodies forced us to pay attention to our own experience of 'with-nessing' (Ahmed 2004; Atkinson et al. 2021: 24) bacteria, thereby helping us to ask broader questions about how medicine knows the body. Being constantly aware of the threat of falling ill and the conversations about the abundance of microbes in the environment helped us to articulate an analysis of the diffractions of the body within the vaccine trial setting. This awareness further affected our understanding

of the vaccine as containing an element of 'holobiont relationality', which we explain later in the text, rather than merely a technology of purity and hygiene. As an integral part of our ethnographic observations, our bodily, sensory 'with-nessing' with microbes, underscored that, instead of being a delineated entity of its own, the human body is an open-ended, dynamic (Wolf-Meyer 2017) assemblage of various more-than-humans, even when technologically mediated (Haraway 2008, 2016; Huttunen et al. 2021; Huttunen and Oinas 2024).

As we sought ways to consciously and meaningfully co-exist with critters—understanding that complete avoidance was an impossibility—we began paying attention to the ways the vaccine researcher(s) described the vaccine as a technology that enables living with creatures, instead of simply safeguarding the purity of the body. Furthermore, being often severely ill ourselves brought the vulnerable individuality in the embodied co-existence with bacteria, along with our reliance on medical advice and care, to the fore.

In part, attuning to our personal bacterial with-nessing enabled us to suggest that an open-ended, pluralistic orientation to relationality with the more-than-human is also embedded in vaccine research in a more complex way than the trial science at face value suggests. Diverse ways of understanding, and even encouraging, relations between humans and microbes may even emerge within one vaccine study. Such human-more-than-human encounters also remind us as social scientists that it is important to take the situational micro-nuances into account, at and beyond the 'edges of science' (Huttunen 2024). Practices occurring outside of what is in the protocol and conventionally understood as scientific may also matter for knowledge production in significant ways.

This analysis is influenced by two classic works in particular. Emily Martin (1990), who has for decades studied how culture influences contemporary biomedicine, showed that, in the United States, images of the Cold War crept into depictions of human bodily immunity in the 1980s. Donna Haraway (1991: 205) similarly detected Cold War imagery in her 1990s work on immunity. Interestingly, she later found the ecological 'holobiont' an apt metaphor for contemporary embodied entanglements (Haraway 2016). Whilst these works are situated in the US context and in a different geopolitical era, together with the more recent literature on microbial relationality they have provided a fruitful window via which to understand the simultaneity of an idea of carefully guarded bodily boundaries and immunity as war, along with a more borderless, more-than-human co-existence. Drawing from the earlier works of Martin and Haraway has emphasised the temporal layers in medical scientists' ideas about the body.

To analyse and articulate the diversity in how the body and embodiment emerge in the vaccine trial, we employ the notion of diffraction here. Donna Haraway (1997: 16) introduced diffraction as an analytical optical metaphor, as 'the effort to make a difference in the world'. Karen Barad's (2007: 94) notion of diffraction is a trope that attends to the relational nature of difference and the effects of that difference. Furthermore, Karen Barad (2007) suggested that science performs acts, 'agential cuts', such as measurements and other practices, where a specific materiality comes into being. While the body that is diffracted in a measurement is 'real' for that moment, it can also diffract into multiple unexpected outcomes in the next 'intra-action' (Barad 2007: 176). In other words, an object is determined within the

apparatus of measurement, through an agential cut albeit only temporarily. It does not have a stable essence beyond the apparatus and thus is remade each time it is measured or observed (Barad 2007).

Diffraction exists the moment when real, lived, and discussed agential cuts, statements, or experiences of the body refer to wildly different understandings of what the body is, but are simultaneously real for those enacting them. Diffraction can happen in the laboratory when the trial staff prepares stool samples and discusses lunch plans, all the while considering one colleague's worsening nausea, as well as when a social scientist writes about such events. The intra-action refers to the dispersed agency that appears as a stomachache, suggesting that entities and 'things' do not precede action, but are themselves constantly made and re-made—intra-acted—in dynamic relations and entanglements (Barad 2007: 141). Here, intra-action includes the relational agency of the bacteria, the gut, the social life, and the global structures enabling a certain experiment to proceed and a vaccine trial to be conducted.

One important observation that triggered this analysis was the personal experience of having to deal with multiple messages around the threat of diarrhoea: Will I get it from touching a bottle? Or eating street food? Similarly to the staff and participants of the trial, we as ethnographers were constantly discussing ways of catching 'it' and the inconveniences accompanying fieldwork—that is, not having time for that bodily element of our research topic. There were contradictions that first seemed like irritating inconsistencies: How can some of the discussions with the same scientists outlay the contours of the body so clearly in one version of the body, and then be all gone in the next moment? As social scientists, we struggled to identify the many ways in which knowledge in practice is *not* stabilised. Thus, by taking our own embodied encounters with bacteria seriously, we could detect how the imagined and enacted bodies in vaccine trial science are never stable. Through diverse practices and daily incidences, the body is diffracted into many potential possibilities—it multiplies and *is* different things in different moments.

We describe (see also Huttunen and Oinas 2024) four versions—or diffractions—of the body, two of which we consider peculiarly entangled. First, the numerical body is imagined as numbers, produced through counting, computing, and estimating the trial data, but also through everyday craft and tinkering. Second, the contingent, vulnerable individuality of the body made itself apparent during bouts of illness. Third, the holobiont body exists alongside and interwoven with the fourth, individual entity-body, the borders of which must be carefully guarded. The holobiont body is the imagined body of the vaccine-induced immune response where the contours of an entity are no longer definite, but a self is dispersed within an entangled co-existence with other 'critters' like bacteria (Haraway 2016)—even if inactivated. These diffractions were discussed in an earlier article (Huttunen and Oinas 2024). However, when writing that article, we did not explicitly consider the significance of our own experiences of illness when formulating the categories.

DATA AND METHODS

The data presented here represent snippets of encounters during a phase 2b vaccine trial conducted from 2017 to 2019. This trial, like all trials, was both standardised and unique. It tested an oral vaccine intended to prevent both travellers' diarrhoea in travellers as well as in military forces, and infant diarrhoea in so-called low- and middle-income countries

(LMICs). The vaccine consists of inactivated enterotoxigenic *Escherichia coli* (ETEC) strains and an adjuvant that increases the immune response. The phase 2b trial is only a small part of the entire process in vaccine development, where the safety and efficacy of the vaccine are examined. An additional benefit for the scientists was the opportunity to generate data aimed at improving the broader understanding of how human bodies deal with bacteria, including data about antimicrobial resistance. The long-term goal of developing a vaccine for children in LMICs was also highlighted when communicating with participants and popular media (Huttunen 2024; Huttunen and Oinas 2023).

The protocol outlined that the trial population consisted of approximately 750 adults from Finland who were required to travel to Benin. In batches of 7–35 tourists at a time, they spent two weeks in the pseudonymised Beninese coastal village, Ville, giving blood and stool samples before, during, and after their trip, and recording their health and bodily functions in a daily chart. A small research centre with some laboratory equipment operated onsite for nearly 21 months. Bioanalysts handling the samples and doctor-coordinators and assisting coordinators were employed as trial staff. They were Finnish and lived in Ville for periods ranging from one to three months at a time.

Finnish trial participants were recruited primarily for their 'naïvety' with regard to the vaccine and the bacteria: they had not previously been exposed to the ETEC bacteria in question in their living environments and thus had not developed immunity against it. Moreover, the modest use of antibiotics rendered Finns a suitable study population—this is a reminder of the social construct of the Finnishness of the trial and the understandings of the body within it. The original plan of the company developing the vaccine was to collaborate with a section of the US army and recruit US soldiers as trial participants instead of Finnish 'trial tourists'. The change in plans was due to the extensive use of antibiotics in the intended study population, since antibiotics drastically change the microbial environment in a person's bowel. Instead of being merely anecdotal, this incidence is descriptive of the larger phenomenon of problems the US pharmaceutical research industry faces due to the extensive use of antibiotics and other medicines (Petryna 2009). This incidence also emphasises a significant difference in the immune system, the body, and its relationality with microbes, and how these are understood in the US and in Finland—along with the ways the respective countries' healthcare systems have been organised.

We, the social scientists and authors of this article, followed the science-in-the-making by spending time observing, interviewing, and filling out questionnaires with the tourists, scientists, laboratory staff, tour guides, hotel staff, and villagers, in chunks of varying time periods throughout the duration of the trial. Altogether, we spent 8 months at the trial site in Benin. Elina spent 11 weeks in Ville across three separate stays, and Katriina spent six months there during three separate visits. In addition, interviews, phone discussions, and lunches where the trial and other elements of the doctor-scientists' work took place occurred in Finland, even after the data collection phase of the trial had ended. Like many others, we both fell ill during our fieldwork, received advice and support from the Finnish trial staff, and we joked and laughed about diarrhoea, worried, and eventually recovered, even if only after receiving heavy medication in Finland.

This paper discusses our analysis based on the encounters and conversations with the trial staff, especially with the doctor-coordinators,

during these years, rather than the tourist-participants who appear in other publications (e.g., Huttunen et al. 2021; Huttunen and Oinas 2023; Huttunen 2024). All names are pseudonymised. The entire data set comprises more than 500 pages of field notes from months of participant observation in Benin and at home in Finland; 195 qualitative interviews with staff, people living in the village, and tourist-participants; and a two-part survey with 542 and 493 replies from tourist-participants. We have documented both information lectures and passing chatter during meetings, on buses, and in toilet queues and restaurants, and conducted lengthy and focused interviews. Often, the beachside conversations with the trial's staff proved to be as informative as the well-rehearsed lectures with tourists and the media.

The moments we discuss here offer examples where the varying aspects of engagement with knowing the body became apparent to *us*—for the scientists some of these incidents are irrelevant, since they regard the parameters of the protocol as a definite dividing line for what are 'data'. The analytical method here focuses on moments that are rather typical and which re-occurred during data collection. One of the quotes is from the original field diary; the rest are subsequent reconstructions.

This article aims to discuss more-than-human ethnography and show how an explicit focus on bodily attunement enabled our original analysis in an earlier article (Huttunen and Oinas 2024). The original analysis is enriched with explorations of our own embodied experiences which attuned us to specific kinds of analytical observations. We present these as snippets at the beginning of each section of our analysis. Ultimately, our aim is to demonstrate how our very personal negotiations of our bodily boundaries allowed us to ask new questions or change our approaches.

ANALYSIS

THE BODY IN NUMBERS: ACHIEVEMENT THROUGH A PROTOCOL AND NETWORKED, CREATIVE CRAFT

Elina's field diary:

> 18 July 2017. Tuesday morning. I'm still quite sick, have diarrhoea, and feel weak. I slept, but I had horrible dreams. Another bout of diarrhoea in a row, not nice. Could this be because I stopped the medication?
>
> The second group will arrive tonight. Sigh, that is supposed to be nice. (…)
>
> Now on the bus at the airport waiting for the next group. They must be completely upset, maybe even furious, after spending a whole day in Arlanda [due to a missed connection]. It must be frustrating; but if they have been able to turn that into an adventure, they are really motivated. Today, they flew all day, Stockholm–Brussels–Cotonou. And the bus trip to Ville. We'll probably get there very late. I try not to stress.
>
> Am I coping? My diarrhoea and feeling sick just continue. I think I'll try to rest tomorrow and take it very carefully. And still get to know the new travellers—
>
> 19 July 2017. Yesterday's car trip was probably quite pointless when I was so unwell myself, but I got the impression this is a good group, really. Ages 19–64, all kinds of people.

The field diary above was written by Elina in anticipation of the second group of tourists about to arrive in Ville. She felt sick, exhausted, and anxious about the next 30 participants she was supposed to engage with after just having acquainted herself with the first group. In

addition, the trial staff in Ville and the people in the village required her attention. The second group's sheer size and her own bodily state of not quite coping with new data-collection expectations underscored the large number of people involved in a trial. This realisation also made clear the fact that, unlike in ethnography, the almost 800 trial participants will not remain individuals. They will be processed into numbers, the larger the better.

The most dominant diffraction of the body in any vaccine trial is the way the trial deconstructs the body into numerical data and then re-assembles it to derive a statistical average that can prove the efficacy of a vaccine. The standardised procedure is extremely complex and involves the orchestrated labour of hundreds of people (Merz 2021). This trial was no different, although the extent of the effort, and especially the creativity and craft it required from all, remained one aspect that seemed to surprise everyone. The body depicted in reliable numbers is the recognised, 'self-evident' outcome of the trial, and a massively laborious accomplishment. The individual body dispersed into data was achieved at various stages of the trial, not only in the final statistical analysis. The everyday craft and embodied 'labour' constituted the origins of knowledge in this trial, and in biomedical research more broadly (Meskus 2018).

For us sociologists, the first fieldwork encounters consisted of meetings in Finland before the trial began, often with the pharmaceutical company leaders who flew in for quick daytrips or whom we met online. The tone during these business meetings was always busy, serious, and organised, but also excited and only slightly worried—Will there be enough volunteers who sign up for the trip? Will the lab building be ready in time? Will buses and petri dishes pass customs? The sheer number of details that needed to be taken care of remained dizzying, from hotel billing and logistics to concerns over US investors and collaborators. The massive effort of the double-blind, randomised controlled trial (RCT) with a recruitment goal of nearly 800 participants, intended to generate tens of thousands of stool and blood samples which were subsequently flown across continents, inevitably becoming an assemblage (Latour 2005) par excellence, with entanglements, diffractions, and unexpected risks hard to foresee and anticipate.

Within the practice of a trial, numbers and probabilities are constituted by thousands of entanglements where individual bodies are deconstructed. The trial attempts to position them specifically and transparently. Yet, inevitably, as living beings, they are ultimately uncontrollable. The body in numbers is thus a nonspecific body. Furthermore, the individual body that participates in a trial is both the lived body of the individual in the trial site, and a constantly transforming one, a body entangled in an environment in restaurants, bathrooms, and aircrafts brought into the picture through participation in a trial. The pathways that comprise these entanglements are known to an extent, and the trial staff is tasked with attempting to chart them in a way that makes the trial procedure reliable vis-à-vis the standards set by medical and pharmaceutical sciences, industries, and regulators. The staff also advised participants on how to protect their health, first as pre-travel advice and later as guidance during a three-hour welcome session.

Our ethnography started around the time the laboratory was preparing for the first research participants. The first months were a mix of simultaneously serious, excited, and optimistic emotions. Those meetings during the initial months made it clear that, whilst the trial

was taking place in Benin, a lot went on within networks of craft internationally (Meskus 2018). A large team tried to unveil, foresee, and control the many potential problems both anticipated and avoided in the multiplicity of the entanglements of a trial. Even when following a script and a guideline, a trial is always unique on a practical level. Despite everything progressing well, actions related to details are constantly improvised and mini-crises are creatively avoided.

Some events could not be foreseen, including when a connecting flight was cancelled. But the team found solutions in order to allow it to stick to the timing of events outlined in the trial protocol. The daily work of the biomedical laboratory scientists (BLS) and research nurses also involved innovative and creative orchestration. Whilst pharmaceutical research has a strict hierarchy with the principal investigator (PI) assuming ultimate responsibility, appreciation of the skills and commitment of all staff is crucial for the trial to meet the regulators' demands. This was also apparent in the information sessions for the tourists. The participants' role in the success of the trial was underlined, primarily by explaining the logic of the vaccine to them in lay terms and with care.

An example of social creativity from the later data gathered in Benin can be found in the first information session for newly arrived participants. The team had come up with an efficient way to inform participants regarding how to identify the fluidity of a 'proper diarrhoea' sample to be recorded on health cards: 'if it is loose enough to be drunk as if a milkshake with a straw, it qualifies as the right diarrhoea'. The milkshake metaphor elicited many laughs and easily remained in one's mind. This helped participants tick the right boxes on their health cards, which served as primary data generation document. Identification of the right type of stool was otherwise not simple, given that there was no universal definition of diarrhoea shared by all stakeholders.

This kind of work is especially challenging when ill and trying to fill in a card with many details. The milkshake reference became a permanent way to instruct participants throughout the study. Such everyday creativity, passion, and reliability across roles and academic hierarchies were very much embodied amongst the staff present in Benin. For instance, one staff member who remained in the village for the duration of the trial, from the outset laughingly presented herself as the Queen of Shit. Such humour did not undermine the scientific appearance of their work, but, rather, fascinated both lay participants and us social scientists.

Elina, field memory:

> Waving the bus off to the airport with group 18, the spirit of the remaining team is happy and relieved, but a few celebratory minutes later already busy. Me and 8-year-old Ida lie on the lab bed doing her homework for school in Finland, whilst her parents go through each health card and see if they can find any unclear boxes. When they do, they call the mobile on the bus and check with the traveller—'Hey, Pekka, did you stay in bed all day on Wednesday, no meal at all?' 'Kaisa, was it yes or no to a headache on Tuesday?' Often, they get an answer; it is so much better to check now than after they leave Benin, or never, they explain to me. An hour later, another batch of health cards, leading to tens of thousands of numbers, is clear. And we can go and swim.

The everyday craft of the trial exhibited a sincere commitment to the end goal of reliable evidence

about the safety and efficacy of the vaccine—that is, reliable numbers. Anthropologically, it is interesting, even if unsurprising, that scientific validity and reliability are mundane matters resulting from relentless daily social conduct. Whereas for RCT scientists, protocol violation is a clear matter of reporting, social scientists view adherence to methodological guidelines as always necessitating innovation. In practice, this was laborious. In Finland, each participant visited the clinic three times. During the two-week holiday in Benin, this was even more so, consisting of two formal information sessions, three one-on-one consultations with each participant, and checking participants' completed health cards upon which they reported bodily functions in detail, from headaches to meals and bowel activity.

This meant, at times, phone calls to drunk or sick tourists whose cards were missing or messy and extra care needed to collect the required information and samples from participants. Most tourists were compliant and eager; but, on every trip, there were individuals coordinators needed to babysit or support through hardships. The hardships were numerous, whereby half of the participants got ill with diarrhoea, even if often mildly so, although other illnesses also occurred. The staff also kindly consulted us, who at different points during the post-fieldwork periods back home were diagnosed with *Shigella*, giardia, a urinary tract infection, and a plethora of milder diseases—conditions that certainly helped us appreciate medical advice and care and which nuanced our analysis.

We witnessed frequent serious and humorous conversations about potential problems. Avoiding errors regarding the trial lay at the centre of the staff's work and immediately followed the goal of keeping everyone alive, as one staff member jokingly put it in the information session upon arrival. It was possible to achieve a clean record. The constant human tinkering during troublesome situations was intended to maintain the methodological reliability of the study, not to obscure errors. The staff aimed to diffract the lived bodily experiences of the participants into reliable numbers, into data. Surprisingly, our own bodily sensations helped to grasp the numerical diffraction, whereby their materiality was so obviously different.

Whilst the body in numbers demands a huge amount of everyday craft and faith in its relevance, the science does not exclude other ways of imagining the body. Based on our observations during this trial, we suggest that the execution of a method in a particular situation is needed to momentarily stabilise knowledge for specific uses. However, it does not remove alternative versions. The trial result, then, is also an 'agential cut' (Barad 2007; Irni 2013), necessary for pharmaceutical development. It creates reliable outcomes for such needs (Cartwright 2007). In the next section, we show that the trial body in numbers co-existed with the individual, vulnerable body.

THE VULNERABLE BODY

> Katriina sits in an outdoor restaurant with a new group of trial participants, eating a salad with local cheese. She attempts to get acquainted with these new participants, but her attention is constantly disrupted by an increasing pain all over the body. She mentions to others that she is feeling a little weird, but does not want to make a big deal out of it. She is bothered by and even embarrassed by not being able to engage in the discussion properly. As she feels that her fever is probably rising, she regrets her choice of meal—Should salads not be avoided as they may be washed with

tap water? Lunch ends and she decides to head to her house to rest and check her body temperature. As she walks on the paved road, she realises that the jolts caused by each step cause pain in her spine. The pain keeps increasing as she walks, and she tries to take steps as steadily as possible. She starts to panic because of the pain in her spine, which she thinks must be a sign of something serious.

When she gets to the house where she resides, she calls a Finnish nurse who lives in the same area and is doing her internship in the healthcare centre of Ville. The nurse tries to calm her down and arrives at her place quickly. Soon after that, the vaccine trial's doctor-coordinator arrives by her bedside, asking questions and testing how her neck bends. The doctor-coordinator seems relieved, as the symptoms do not indicate meningitis after all. Katriina feels like a child. She is relieved that the doctor-coordinator is there and ready to help her, even though she is not a participant in the vaccine trial. She is impressed by what appears to be the doctor-coordinators' devotion to and responsibility of their profession.

The text above is a subsequent recollection of Katriina's sense of personal vulnerability and, importantly to our analysis, of care. Whilst the aim of the trial was to collect useful and credible data and not to care for or cure individuals as patients, we frequently witnessed attention to and care for an individual's health concerns, as well as to them personally. During these moments, neither worry nor pain nor grief were downplayed. For us, these reminders were about the trial body being constantly diffracted into numbers and new patterns, whilst, simultaneously, the scientists were also practitioners of medicine. This practice reminded the scholar of the individuality, fragility, vulnerability, and grief accompanying pain or a fear of the loss of lives. The issue of care is descriptive of how unanticipated questions arose during our fieldwork periods.

When the bus transporting the very last group of trial participants to the airport left the trial site, the principal investigator, to her own surprise, had a strong emotional reaction. According to her, it was the relief that the trial participants had all survived and without any severe accidents. She had considered herself ultimately responsible for the health and safety of the participants. Thus, while the body of numbers mentioned at the beginning of this article comes to the fore in the study protocol, the individual body does not disappear from the view of the scientists. This example also demonstrates how the ethics of medical research (with its emphasis on the safety of study participants) is always a priority, and not merely a question of guidelines and protocol. Thus, it was experienced in a thoroughly embodied and affective manner by us as well.

Elina ended up in isolation in a rural-area hospital after arriving back in Finland and similarly found the attention and care of the trial PI through frequent phone calls extremely reassuring. The isolation room experience, however, underscored the stark paradoxes within medicine. On the one hand, isolation is a standard precautionary measure when a person returns home with unidentified symptoms from a tropical climate. On the other hand, the patient is left feeling entirely delivered into the grip of the welfare state panopticon and the biopolitics of surveillance. The professional, excellent formal care of the hospital staff, and the extra care of the trial PI by phone, however,

allowed Elina to see that biopolitics and individual attention to a personal vulnerability are not mutually exclusive.

The topic of care for the individual patient emerged often when discussing particularly intriguing patients in doctors' work in general. At times, comments centred around some patients not being diagnosed correctly without a face-to-face encounter. Taking a hunch seriously requires the professional competence of an experienced doctor who can suspect an entire range of issues, not just the most obvious. During an interview—after the trial data collection phase had already ended—one of the doctor-coordinators of the trial referred to a similar hunch when she had to make a major decision about procedures regarding one trial participant. Her decision to act turned out to be correct; in her explanation, a particular kind of feeling, based on all her work experience and her ability to pay careful attention to certain signals, led to her decision.

One interviewee, a doctor-coordinator, described the different logic of a trial compared with the clinical logic of care of the individual's health as follows: in the everyday work of medical practice, the point is to 'just take care of things' and get health problems fixed, rather than to focus on recording everything carefully. As she put it, 'I'm used to that (…) it's enough that the throat ache is gone. Then, in this case [the trial], it's not at all the point that the sore throat is gone, but that it's properly recorded in all the places. So, I kind of had it the wrong way in my head at first.' This brings to the fore the 'inconsistencies' between what we have called the body in numbers and the vulnerable individual body that requires care. The advice for doctor-coordinators was that participants' health takes priority, and everything else comes after that, whereby these different logics required constant balancing. In her study on these differing ontologies of a trial, Charlotte Brives (2013: 411) suggested that patient-participants acquire new skills and knowledge and take on new corporeal practices. In our study, those conducting the scientific work needed to negotiate the different versions of the body to properly perform both the scientific and the ethical tasks.

These stories remind us social scientists that patient encounters and the skills to conduct them root medical researchers in their roles as doctors. Similarly, the doctor-coordinators in Ville spent a lot of their time consulting individual participants on how to cope with diarrhoea, calling participants several times a day when needed. The attention to the individual did not stop them from seeking statistical probabilities. Instead, the vaccine trial and those conducting it managed the numerical body of the double-blind trial, and the individual, unique body that needed to be seen and spoken with, and who may suffer severe consequences even in the hands of a competent doctor. The insight of vulnerability does not guide scientists away from the double-blind trial body, but guides them to work *within* it. Similarly, our own bodily vulnerability, periods of bodily pain and fear, and the help we sought and obtained during and after our fieldwork, forced us social scientists to notice the centrality of care in the scientific imaginary of the body. Our bodily co-existence with bacteria helped us to broaden our analytical scope beyond attention to the universalised, numerical trial outcome body alone.

THE ECOLOGICAL, SYMBIOTIC HOLOBIONT ALONGSIDE HUMAN EXCEPTIONALISM

At the very beginning of her first of three travels to Ville, Katriina brushed her teeth with tap water in her bathroom, simultaneously thinking that she found it somehow amusing that the trial participants are advised to brush their teeth with bottled water. She was concerned about the amount of plastic water bottles she would use during her stay and thought that it was a waste of water to use it for brushing her teeth, and that one should be able to deal with such a small amount of previously unencountered microbes. She assumed that, as she stayed in Ville a little longer, she would encounter various kinds of microbes anyway, and such measures of protection seemed unnecessary to her. She believed she would probably fall ill with diarrhoea at the beginning of her stay, and then be more used to the microbial environment. In that sense, she thought that she could learn to live with the local microbial environment. At that time, she was not sure about what to think about the ETEC vaccine, especially for travellers' diarrhoea. It is natural, after all, to be exposed to different kinds of microbes in different environments. She did, however, take a cholera vaccine before her travel to Ville. Not long after her arrival, Katriina tried food from a small stall on the street. Those food stalls are where people living at the site often eat. During another lunch at a stall, eating bean stew, a couple of local people stopped by to eat, and she chatted with one about the vaccine trial. The stall's location very concretely provided a new perspective on the small research centre where the samples were stored. We are close by, but the trial seems distant. Katriina came to think of how the food stall provided the possibility to mingle with local microbes, but also with people, in a way that might not happen otherwise. She thought that being open to such mingling was important for ethnographic engagement.

During her next stay a year later, Katriina decided to use bottled water when brushing her teeth. During the first stay, she continuously had trouble with her health and was diagnosed with giardia once back in Finland. Then, she had to take antibiotics to get rid of the parasites. In part to avoid that, viewing antibiotics as a necessary evil of a kind, she decided to be more careful regarding her exposure to the microbial environment.

(…)

One ordinary evening during the trial, Elina and a doctor-coordinator sat comfortably in the hotel in lounge chairs in Benin, sipping pre-dinner drinks after a long day of work at the trial's research centre. The scientist, never too tired, explained vividly how the vaccine works in an individual body. The story was not about the large numbers of bodies in the trial population, but about a body emerging in an intricate interplay of entangled elements. The depiction reminded Elina of Donna Haraway's (2016) holobiont. Elina had been observing her own rather vague concern about how to not view the tropical surroundings as hostile and dangerous, and yet remain healthy. Approached from the perspective of the holobiont, the human body is a seamless participant in the ecosystem, where bacterial and genomic flows are inevitable and hard for

> a human to control. Later, when discussing her thoughts with the doctor, Elina realised that there is no way of precisely establishing if there is any real similarity between the doctor's view and Haraway's holobiont.

It is possible to interpret vaccine logic as suggesting that this vaccine does not fight the bacteria, but teaches the body to live *with* it—specifically through exposure to a modified version of the ETEC bacteria. In the doctor-coordinator's description, the body learns to interact with ETEC for the next encounter in such a way that no harm occurs to the body. The vaccine imitates mild exposure, helping the body cope better in an abundance of gut-level entanglements found in tropical conditions. One significant element is that this vaccine is administered as an oral liquid, and, therefore, the mucosal immune system plays a key role in the immune reaction. When ingested, the gut processes the confrontation in a similar way to how it would interact with actual bacteria, albeit in a safer way for the human. The dynamic learning process within the gut is the key issue.

One important interpretation in social scientific terms is that a less cautious, more ecologically dynamic holobiont life is possible with such vaccines compared with everyday occurrences whereby one constantly 'micro-protects' to live with invasive, harmful microbes (Huttunen et al. 2021). Another interpretation suggests that the holobiont body is constantly evolving in its environment. Rather than remaining static, the holobiont body is a vital, embedded organism within a larger whole. Importantly, the vaccine is a human-made element—or technology—introduced into the ecology of the gut, thereby challenging the stark divide drawn between nature and culture/technology. The distinctive human-centredness is in question here, with a holobiont-cyborg mode of existence prevailing (Haraway 1991, 2016). A natural, dynamic bodily learning process does not lie in opposition to biomedical technologies.

The renowned biologist Lynn Margulis (1991), who introduced the concept of the holobiont, underlined the importance of multi-species symbiosis for mutual and collective development. Following Margulis, embryologist Scott F. Gilbert (2020) suggested that there was a paradigmatic shift from twentieth-century biology focusing on entities, competition, and stability towards the holobiont view of 'living with' in unstable, but necessary entanglements.

We suggest that the vaccine logic 'queers' what Oikkonen (2021: 23) labelled 'culturally prominent ideas of immunity' which 'mobilize normative assumptions of bodily boundaries and encounters between bodies'. The ecological-technological holobiont logic of the vaccine also challenges the suggestion that individual immunity automatically 'resonates closely with the imaginaries of eugenics and racial hygiene', which Oikkonen (2021: 34) recently maintained in her study on 'post-pandemic futures'. Based on our study of the vaccine trial in Benin, we argue that to condemn the affective appeal of immunity as inherently negative overlooks the possibility that immunity can mean a desire to live *with*. The immune response means that an organism, such as a bacteria or a virus, is incapacitated in the gut, but does not need to be eliminated in the immediate environment. Co-existence is rendered possible.

Here, the gut is a vital organ which constantly learns and changes according to its environment: its capacity to adjust, even if temporarily, to new influences is the key to the vaccine—as for vaccines in general. This vaccine is based on inactivated bacteria which train the body to live with it in the environment, in

quite similar (albeit less painful and dangerous) ways to how the body learns to live through an illness. The adult trial participants are viewed as enormous, healthy, yet vulnerable babies when exposed to tropical microbiota. The vaccine alleviates the pain and danger of that encounter by prompting the body to do what healthy bodies do: they learn and become skilled in co-existence and mutual attunement as the immune response is activated (Frost 2020, as cited in Tamari 2021: 91).

In this view, the immune response is not regarded as a form of war in which the body encounters 'foreign' antigens and mobilises an array of biochemical agents to 'eliminate the putative threat of otherness' (Shildrick 2019: 15). Instead, the immune response is understood here as a prerequisite to co-existence, of with-ness. The idea of such co-existence and acquired immunity generated through a vaccine as 'natural' is especially interesting in light of research on vaccine denialism and hesitancy. According to some, one reason to abandon vaccines is a preference for a natural, and, therefore, a presumably healthier immunity and immune system developed through encounters with actual pathogens (Nurmi 2021). The notion of naturalness is in question. Similar to Helosvuori's (2021) suggestions in her research on infertility treatments, technology—in this case, the vaccine—connects immunity to specific forms of naturalness rather than prevents natural bodily processes. Thus, the holobiontic views of the vaccine and the immune system complicate the boundaries of what is viewed as 'natural' or 'unnatural', allowing new forms of 'naturalness' to emerge.

Yet, the scientists also expressed views that go against holobiontic contourlessness. However ecological their approach may be towards the gut, a holobiont view of co-existence was often confronted with a human-centred view and a need to maintain some boundaries. Human medicine harbours a commitment to human exceptionalism and human-nonhuman boundary work. The entity medicine is designed to care for is the human, according to one of the doctor-coordinators, an argument offered when discussing multidisciplinary collaborations. In a conversation about the One Health paradigm, which recognises the intertwinement of the health of humans with that of other animals and the environment, one staff member stated that medicine is by definition human-centred, which is not an ethical dilemma for them despite many being devoted animal lovers. In this way, the body is not imagined as fully immersed in an ecosystem characterised by complete fluidity; rather there is species specificity, individuality and entity borders (cf. Pradeu 2019; Gilbert et al. 2012).

When discussing pathogenicity, the scientists often underscored that bacterial encounters should not be feared as such. A healthy body needs microbes, and copes with some pathogens in reasonable amounts. This arose, for example, when discussing the assumption that the trial could put participants' health at risk, but also when observing staff members' personal eating behaviours, which varied widely. Many chats featured an element of minor 'war and border controlling' (Huttunen et al. 2021), recalling the metaphor of the human body as a well-functioning state for which some level of border control is assumed as necessary (Martin 1990; Haraway 1991). Every bite could be a moment of consideration and discussion, perhaps due to the trial topic's presence, but also because of the new or foreign food environment. For example, at a buffet table when she considered a leaf of lettuce, one staff member explained that what matters is the amount of bacteria, and then rejected the salad at that time. Another staff member underscored

the importance of one's pre-exposure health status and prior immunity.

Here, co-existence with bacteria is not a life in 'natural' harmony (Halberstam 2020: 7). However, one seeks to find a relaxed balance between a good life with friendly bacteria, and an awareness of a potentially vulnerable individual body in a potentially hostile situation where one does not wish to be surprised by a crowd of nasty critters. Later, in her comments for this article, a scientist described her view as follows:

> Bacteria are mostly friendly and I make very little effort to avoid them, less than many others. So, for me, life is not at all a fight against bacteria. Then, there are those that often cause health problems. It is like ice on a lake: great to ski and skate on, but stupid to go out there when the ice may be too thin to allow you to enjoy it. So, no constant struggle, but caution when you know that there may be bad consequences.

As in the salad scenario, there are many private meal situations where caution rather than a willing ecological merger of oneself with the local natural microbiota arises. Some did not approve of the choice of a staff member who went so far in the ecological practice to start drinking tap water, but neither did colleagues interfere, since personal integrity and freedom to make choices were valued. When sitting with the laboratory staff at lunch, the conversations easily became more private and personal styles of exposure were discussed as a constant balance between being careless and varying everyday practices—How much effort is worth the trouble to limit exposure to pathogens? The body is also a work tool and thus an individual entity one must protect, yet not think about constantly. Frequently, someone fell severely ill, but was never blamed for carelessness.

At the trial site, some individuals also mentioned not having taken antibiotics for a decade, referring to an intentional avoidance of them. Amongst the trial participants, antibiotics were not advised unless the situation was decidedly serious since their use would affect study participation, but also because general concerns have intensified regarding the spread of resistance due to the careless use of antibiotics. Many, but not all, staff members expressed a similar view towards antibiotics: if possible, one should avoid them, although at times they are simply necessary. The trial could prove that monitoring by a doctor helps, and unnecessary antibiotic use could be avoided through a doctor's evaluations, for instance, via regular, supportive phone calls checking in on a patient's mood and wellbeing.

These private and professional behaviours amongst trial scientists exhibited some similarity with the imagined 'immunity as warfare' typical for the Cold War era (Haraway 1991), *alongside* the contemporary emphasis on co-existence and the holobiome (Lorimer 2020). As explored by the feminist classics on imaginaries and discourses on human immune systems, Donna Haraway's (1991) *Simians, Cyborgs, and Women* and Emily Martin's (1994) *Flexible Bodies*, in the context of 1980s US, the human immune system was depicted as a militarised field of warfare, all while transforming towards a neoliberal flexibility. Whilst Haraway and Martin wrote specifically about the US context, similar notions and cultural imageries of the immune system as a warzone travelled more globally and appeared, for example, in the animation series *Once upon a time… Life* (Barillé 1986), which was also highly popular in Finland in the 1980s [*Olipa kerran elämä* broadcast via YLE,

original *Il* était une fois… la Vie]. The human-centred entity approach in our case moves away from these metaphors drawn from the situation of one hegemonic nation-state during the Cold War era, in which it defended itself with threats of deploying a nuclear arsenal. If, in this conception, the immune system fought bacteria with an explosion of antibiotics, the vaccine trial's nation-state body today defends itself from overwhelming numbers of particular kinds of evident pathogenic outsiders, whilst still knowing that interaction is inevitable, even desirable.

The 1980s' Cold War influenced the metaphors of the human defence system, reflecting the societal tensions of the time. The bodily imagery today also accommodates the more subtle analogies of a surveillance war, and the symbiosis of the holobiont. Our analysis focusing on tourist-participants (Huttunen et al. 2021) pointed towards the ways in which ideas of microbes and immunity are entangled with broader societal and global relations of racialised imaginaries at play when notions of purity, hygiene, dirt, and illness are negotiated (Chigudu 2020). Despite the logic of the vaccine, in private staff regularly noted that hygiene in the village should be improved and pondered ways of educating the local people on such matters. This was a discussion topic shared with tourist-participants. To our surprise, they did not comment on the local adults having *better* immunity than the Finns, even if regular encounters with various bacteria eventually and potentially strengthened the body. Such an environment was viewed as too risky, and accompanied by a high childhood mortality.

To summarise, our interpretation is that, by design, the vaccine trial staged the body in ecological multispecies entanglements even if vaccine scientists did not use that specific language. The trial assumed that, regardless of human choices, contact is likely, as microbes are amongst us, in and on us in hitherto unimaginable quantities. Trial staff members frequently mentioned that microbes are crucial for our wellbeing and are not essentially pathogenic. Antibiotic warfare against them should be avoided as much as possible. There was also an undercurrent of relationality, interaction, and mutualistic outcomes in the (oral) vaccine logic. In the enactments of the body here, some traces of the discourses of war against microbes emerged and were complemented by what Haraway (2016) came to view later in *Staying with the Trouble*, as human-microbial co-existence of the holobiont. We became aware of these enactments precisely because we also personally constantly participated in the discussions and shifting practices about the many ways of dealing with the unavoidable bodily co-existence with microbes in everyday situations. We worried, hesitated, and just went on with our day, fell ill and got better again.

DISCUSSION

The ethnographic method whereby social scientists follow the same individuals through different situations enables observation of the human-more-than-human relationality and the body multiple amongst a team of scientists explicitly committed to one idea of the body: the ontology of the trial and its body dispersed and again condensed into numbers. In our earlier article (Huttunen and Oinas 2024), we also identified a diverse set of other diffractions of the body. These included the ecological holobiont body of the vaccine, the nation-state defensive body of personal everyday practices of the staff, and the individual, vulnerable body of the doctor-patient relationship (Huttunen and Oinas 2024). All these figured in the same trial when followed ethnographically. In this article,

we have attended to the ways in which our own embodied experiences informed this analysis.

Through snippets of our experiences and encounters with microbes during our fieldwork, we have attempted to demonstrate that the way we understood the trial, the vaccine, and the trial scientists' understandings of the immune system and the human body developed in conjunction with our very personal negotiations of bodily boundaries. Our experiences of illness and being taken care of, along with intimate enmeshment with microbes in Ville, offered us possibilities to ask new questions about the vaccine and vaccine science.

All the different versions of the body are 'true' and should be taken seriously. They have further consequences, and they send off novel diffractions in unexpected ways, yet follow a pattern that can be detected. Often, the pattern is governed by an agreed-upon trial science methodology—albeit one that requires everyday tinkering and hustling. The trial method gives the diffraction its credibility, even if the method itself is a mere construct, a temporary achievement that coheres around a momentary consensus. Based on our embodied experiences, we observed how a consensus about the contours of the body alternated with seemingly paradoxical accounts. These included, for instance, accounts given in the ten minutes between moving from test tubes to lunch salads, exhibiting parallel, inconsistently organised ideas and practices of corporeality rather than cumulative epistemic progress. It is also important to consider that the researchers examined here—both ourselves and the trial scientists—were not alone, and the trial science was made possible by an assemblage of a large number of people, critters and more-than-human actors, along with their creative craft, as well as infrastructures, technologies, and material equipment.

The multitude of human-more-than-human entanglements depicted here convey vastly different and conflicting images of the body usually assigned to different professional groups (e.g., expert vs. lay person, practitioner vs. scientist), or historical eras where ideas only belong to certain decades. Examining the cracks and inconsistencies highlights the multiple diffractive potentialities in science and medical practices. This becomes especially clear when the critical medicalisation researcher falls ill during ethnographic fieldwork, and willingly commits her body multiple times to medical scrutiny and care—and returns to her critical notes documenting the same instance.

ACKNOWLEDGEMENTS

In addition to the authors, Salla Sariola and Mariette Aikpé were involved in the sociological research. We wish to thank them and all our interlocutors during the process of writing this article for their insights and inspiration; all shortcomings, however, remain with us.

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