

BMJ Open Neurosurgeons' experiences of conducting and disseminating clinical research in low-income and middle-income countries: a reflexive thematic analysis

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ABSTRACT

Objectives Low-income and middle-income countries (LMICs) are increasing investment in research and development, yet there remains a paucity of neurotrauma research published by those in LMICs. The aim of this study was to understand neurosurgeons' experiences of, aspirations for, and ability to conduct and disseminate clinical research in LMICs.

Design This was a two-stage inductive qualitative study situated within the naturalistic paradigm. This study committed to an interpretivist way of knowing (epistemology), and considered reality subjective and multiple (ontology). Data collection used online methods and included a web-based survey tool for demographic data, an asynchronous online focus group and follow-up semistructured interviews. Data were analysed using Braun and Clarke's Reflexive Thematic Analysis supported by NVivo V.12.

Setting LMICs.

Participants In April–July 2020, 26 neurosurgeons from 11 LMICs participated in this study (n=24 in the focus groups, n=20 in follow-up interviews).

Results The analysis gave rise to five themes: The local landscape; creating capacity; reach and impact; collaborative inquiry; growth and sustainability. Each theme contained an inhibitor and stimulus to neurosurgeons conducting and disseminating clinical research, interpreted as 'the neurosurgical research potential in LMICs'. Mentorship, education, infrastructure, impact and engagement were identified as specific accelerators. Whereas lack of generalisability, absence of dissemination and dissemination without peer review may desensitise the impact of research conducted by neurosurgeons.

Conclusion The geographical, political and population complexities make research endeavour challenging for neurosurgeons in LMICs. Yet in spite of, and because of, these complexities LMICs provide rich opportunities to advance global neurosurgery. More studies are required to evaluate the specific effects of accelerators of research conducted by neurosurgeons and to understand the effects of desensitisers on high-quality, high-impact clinical research.

Strengths and limitations of this study

- This study is the first to document both inhibitors and stimulators of research conducted by neurosurgeons in low-income and middle-income countries which emphasised the importance of regional context.
- Using a reflexive thematic analysis facilitated an in-depth inductive and interpretive analysis.
- Rigour and credibility were ensured through respondent validation, peer review and reflexive practice.
- This study was limited by its small sample, under-representation of low-income countries and over-representation of South Asian countries.

INTRODUCTION

According to the Commission on Health Research¹ low-income and middle-income countries (LMICs) carry 90% of global disease burden and attract only 10% global expenditure on health research. In 2013, the World Health Report 'Research for Universal Health Coverage'² stated 'all nations need to become producers of research as well as consumers of it' (p.43). Investment in research and development has been growing by 5% in LMICs each year suggesting emerging economies are increasingly investing in research² and increasing their productivity, quality and innovation.³ Despite this upward trend, there remains a paucity of LMIC neurotrauma research.^{4,5} For example, Servadei *et al*⁵ identified only 4.52% of 6708 published reports by those within a neurosurgical department had an LMICs affiliation. Tropeano *et al*⁶ found Latin America, Africa and Southeast Asia had publication outputs of 1.73%, 1.12% and 1.03%, respectively.⁷ Griswold *et al*⁸ reviewed



397 neurosurgical Randomised Control Trials (RCTs) published between 2003 and 2016 and found 73.3% were led by high-income countries (HICs). Within the 26.7% led by LMICs, 71 were led by China, which as the world's second largest economy does not reflect LMICs based on per capita earnings, leaving only 8.8% led by authors in other LMICs. While judgement of capacity based on authorship may be misleading, as first and senior authors of global surgery research from LMIC environments are frequently from HICs, these studies do show that despite the higher burden of traumatic brain injury LMICs are disproportionately represented within the evidence base. Without such studies LMICs are left without a robust evidence base to inform local practice relying on HIC trials which often lack generalisability due to the different environments and treatment practices.⁹

Developing research capacity is one way to address existing inequalities within the health research community.¹⁰ While several authors have discussed the challenges of developing neurosurgical research capacity in LMICs including lack of time and resources,⁵ poor manuscript preparation; poor access to scientific literature; poor participation in publication-related decision-making processes and bias of journals,⁴ there are a lack of empirical studies documenting these issues. Therefore, the aim of this qualitative study was to understand neurosurgeons' experiences of, aspirations for, and ability to, conduct and disseminate clinical research in LMICs.¹¹

METHODS

Study design

This was a two-stage inductive qualitative study situated within the naturalistic paradigm. Qualitative research interprets the meaning people bring to their experiences¹² and the naturalistic paradigm¹³ rejects methods which are reductionistic.¹⁴ Such studies commit to an interpretivist way of knowing (epistemology), and considers reality subjective and multiple (ontology).¹⁵ Focus groups were conducted in stage 1, followed by semistructured interviews in stage 2. The COnsolidated criteria for REporting Qualitative research tool was used to report this study.¹⁶

Participant recruitment and consent

Recruitment of participants to the study was initially through collaborators of the Global Health Research Group on Neurotrauma. Collaborators were employed in several neurosurgical departments in fourteen LMICs and were asked to forward recruitment materials to their colleagues. We anticipated this approach would yield a representative sample of experience and interest in research. However, following three requests to collaborators to advertise the study we did not reach our target sample size. Therefore, we formally amended our recruitment strategy to use social media and advertised a call to participate via Twitter. Those who expressed an interest were sent information explaining the study and invited to a preconsent meeting where rapport was established.

Sample

Neurosurgeons from LMICs were recruited using a purposive approach where participants are selected who are able to inform the research question¹⁷ (see below). Definition of a country as low income or middle income was guided by the 2017–2018 world bank list of economies.¹⁸

- ▶ Neurosurgeon in an LMIC.
- ▶ Self-declared fluency in written and spoken English*.
- ▶ (*one participant asked for a translator for the interview and following ethical review, were recruited to the study).
- ▶ Have access to, and able to use, a personal computer or smart phone
- ▶ Able to provide informed consent

Sample size is typically informed by principles of data saturation.¹⁹ However, this is a contentious issue and more recently researchers are asked to make an interpretive decision about when to stop.²⁰ Recruitment to the focus groups was determined by expressions of interest and we estimated that up to 20 participants for follow-up interviews would be adequate for data saturation.

Data collection

Data collection used online methods to increase participation from geographically remote or isolated centres. While there is some hesitation regarding virtual qualitative methods, these elicit rich and meaningful data.²¹

Demographic data

A web-based survey tool was used to capture demographic details and experience of research/ dissemination using Qualtrics (Qualtrics, Provo, Utah, USA).

Focus groups

Participants were allocated to one of four asynchronous online focus groups defined by income (n=1 low; n=2 lower middle; n=1 upper middle). The asynchronous format allowed people who were in different geographical places and time zones to contribute to a group discussion. Participants were provided with a URL, username and password, to access their specific online focus group and asked to post a brief introduction to themselves. Focus group questions were then posted to the site individually every 7–10 days. Questions were predetermined in consultation with coauthors and were made available to participants in the participant information sheet.

1. What are your personal experiences of conducting clinical research and what personal and/or organisational factors motivate you to conduct research?
2. What specific barriers are there to you conducting clinical research within your hospital?
3. In what ways is research shared between colleagues, the public, and the wider academic community?
4. What would help you to conduct and publish good clinical research?
5. What unique factors are there that should be considered to nurture research capacity in LMICs?

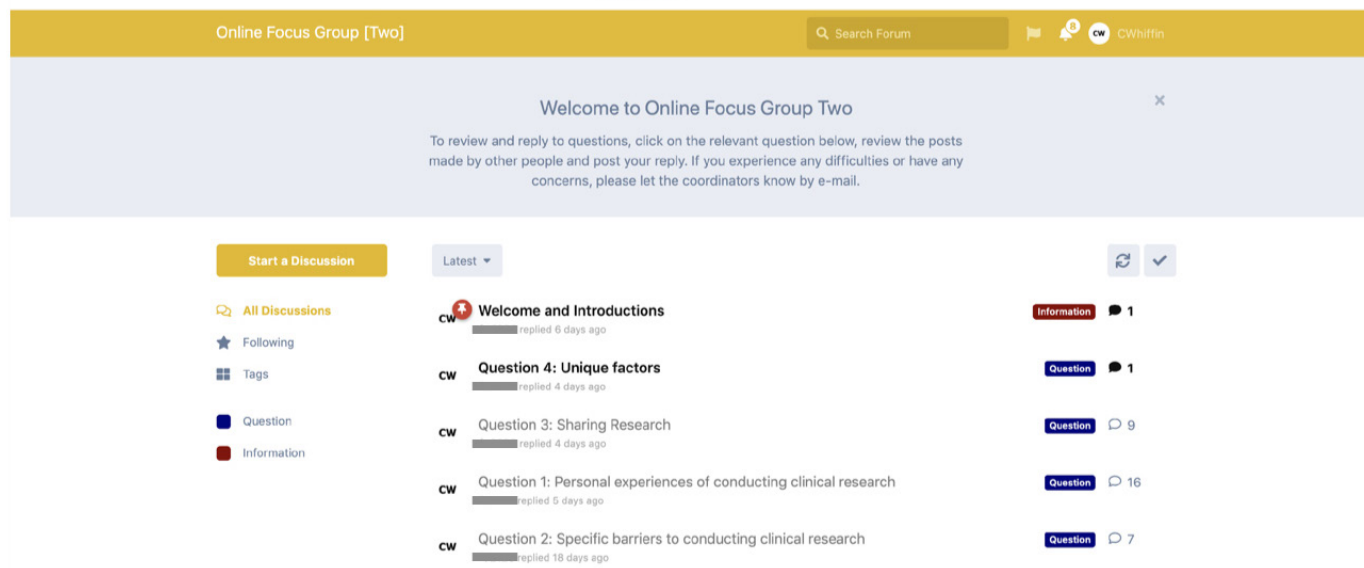


Figure 1 Online focus group platform. (NHS - National Health Service; NIHR - National Institute for Health Research)

Participants wrote their answers in the discussion area of the platform (see figure 1) and were able to view, read and ‘like’ other participant’s comments. The lead author regularly checked the platform responded to direct questions, asked additional follow-up questions and requested clarification where necessary.

Interviews

After the focus groups were completed, data were removed from the platform so it could be analysed. This analysis followed the steps outlined in table 1 and

is described in more detail under ‘data analysis’. From this analysis, we identified the main themes in the data and used these themes to develop a semistructured interview schedule. This schedule was used in the follow-up interviews to allow us to examine the themes in more depth (box 1). No pilot was required as the semistructured format allowed a flexible approach. Invitation to participate was based on demographic details and participation in the focus groups. Four invitations were not responded to and two participants

Table 1 Stages of qualitative data analysis

Stages of thematic analysis Braun and Clarke ²⁵	Methods actioned for phase one	Methods actioned for phase two
1. Familiarising yourself with your data	Read focus group transcripts several times.	Listen to audio files, read and check transcripts, reread transcripts. Make analytical notes and observations.
2. Generate initial codes	Develop coding book by free coding (semantic and latent). Record coding decisions and descriptions.	Develop new coding book by free coding transcripts (semantic and latent). Record coding decisions and descriptions.
3. Searching for themes	Identify patterns through commonalities and differences. Group and order as appropriate.	Identify patterns through commonalities and differences. Group and order as appropriate create categories and sub-categories. Identify the ‘central organising concept’.
4. Reviewing themes	Share with participants in focus group invite review and comment.	Articulate and test out themes check if these exhibit a ‘good fit’. Check if focus group data also ‘fits’ with interview themes. Sense check meaningful interpretation. Identify data not included in themes.
5. Defining and naming themes		Select appropriate names and write theme definitions. Send to participants for respondent validation.
6. Produce the report		Write a vivid and compelling report with appropriate data extracts. Send to coauthors for scrutiny and comment. Recheck interpretation following feedback. Confirm final report.

**Box 1 Semistructured interview schedule**

1. Why it is important that neurosurgeons in low-income and middle-income countries (LMICs) conduct and disseminate clinical research?
2. What do you think would have the biggest impact in changing attitudes and opinions of those who may not see its value?
3. Who do you think is best placed to provide this mentoring and what would you want from a mentoring relationship with other researchers?
4. What would you want from a programme of education and training in research?
5. In recent years do you think the role of research within neurosurgical practice has changed in any positive ways, why might this be the case and how should LMICs ensure these changes are sustainable?
6. How do the government, universities, private and public health-care settings work now and how they might work better to support research?
7. How do you think research conducted in, and by, LMICs authors is perceived by the wider research/academic community and what is important in improving quality of research in LMICs?
8. What role should HICs have in supporting the growth of research in LMICs?

declined. Interviews were conducted in English by CJW, senior lecturer and registered nurse with clinical experience in neurosurgery. CJW is a white British female, PhD educated and an experienced qualitative researcher. Interviews lasted approximately 60 min (range 45–88) and digitally recorded. Field notes were made in a reflexive diary. All interviews, but one, were held individually. The exception was a group interview (n=3) held to enable translation.

International ethical principles, including the declaration of Helsinki²² and the International Ethical Guidelines for Health-related Research Involving Humans,²³ were adhered to. Written informed consent was recorded electronically using Qualtrics, participants were able to withdraw at any time and identifying data could be removed. In recognition of their contribution to this study, participants were asked if they would like to be a named collaborator.

Data analysis

A reflexive thematic approach was taken²⁴ using a six stage analytical framework.²⁵ In phase 1, data from the focus groups were copied into QSR NVivo V.12, stages 1–4 were then completed by CJW. In phase 2, interviews were transcribed by an external company then checked for accuracy. Inaudible sections preventing interpretation were returned to participants as a short member check. Anonymised transcripts were then uploaded to NVivo and free coding commenced again. Theme development was an iterative process that moved codes in and out of categories until a hierarchy of codes, subthemes and themes could be established. Coding decisions and emerging understanding of the data were first shared with BGS who had also read several interview transcripts. Themes arising from the interview data were then checked and

confirmed that they were also representative of the focus group data prior to stage 5 ‘defining and naming themes’. During stage 5, themes were returned to participants to review and comment (respondent validation) and coauthors were invited to provide peer review in stage 6. These steps advanced the interpretation and were not for the purpose of consensus²⁴; however, if there was a difference of opinion we returned to the transcripts to check interpretation was grounded in the raw data. Codes and themes were identified from the data and not a priori (see table 1).

Rigour

Strategies to increase quality in qualitative research are collectively known as ‘trustworthiness’ and are used by qualitative researchers¹⁷ in place of traditional concepts like validity, reliability and generalisability.^{19 26} There are four domains to trustworthiness: credibility, dependability, transferability and confirmability.¹³ Credibility was ensured through the use of respondent validation, member checking and peer debriefing which can limit researcher bias and safeguard against naive interpretation.^{13 27} These techniques have often been used to confirm analysis is ‘correct’. However, more recently it is the competence and reflexivity of the person analysing the data that is of more concern and these techniques are used to ensure meaningful interpretation rather than a ‘correct’ interpretation is achieved.²⁸ Dependability was increased through procedural rigour of following the stages described in table 1 and the use of NVivo to create an explicit audit trail of data to findings. Transferability is enhanced through the contextual demographic data presented and the selection of detailed quotes. Reflexivity was applied throughout by maintaining a reflexive diary.

Patient and public involvement

The research was designed and conducted without patient or public involvement.

RESULTS

In March 2020, 43 people responded to the call for participants, 30 provided consent and 26 took part in data collection (several expressions of interest were for authorship not participation and four who consented were withdrawn for non-participation). Of these, n=24 participated in the focus groups and n=20 in the interviews (see table 2).

The analysis gave rise to five themes: The local landscape; Creating capacity; Reach and impact; Collaborative inquiry; Growth and sustainability. Each theme contained two subthemes which were inhibitors or stimuli of research conducted by neurosurgeons in LMICs. In addition, a number of factors were identified as accelerators and desensitisers that warranted special attention. These themes and subthemes were interpreted within

Table 2 Demographic data and exposure to research and dissemination

		FG n=24	SS-I n=20			FG n=24*	SS-I n=20
Age	25–29	4	5	Experience	Resident	6	7
	30–39	13	9		Within 5 years of residency	6	4
	40–49	4	3		Over 5 years postresidency	11	8
	50–59	2	3				
Sex	Male	21	18				
	Female	2	2	Years working in neurotrauma	<1 year	2	2
Country of residence	Brazil	4	4		1–5 years	10	10
	Colombia	1	1		6–10 years	2	2
	Ethiopia	1	1		10–15 years	5	1
	Ghana	1	1	>15 years	4	5	
	India	4	2	Practice setting (tick all that apply)	Large regional centre	14	11
	Morocco	1	0		Private	9	8
Nepal	1	1	Urban		6	7	
Nigeria	1	1	Public		17	15	
Pakistan	5	5	Junior or senior clinician		Junior	13	12
Philippines	3	3			Senior	10	8
Income classification	Low	2	2	Academic affiliation	Yes	21	18
	Lower middle	16	13		No	1	1
	Upper Middle	5	5		don't know	1	1
Region	East Asia	3	3				
	South Asia	10	8				
	Sub-Saharan Africa	3	3				
	North Africa	1	0				
	Latin America	5	5				
	Middle East	1	1				
						FG n=24*	SS-I n=20
Have you conducted clinical research	Yes					21	18
	No					2	2
Role within research (tick all that apply)	Principal investigator					16	13
	Data collection					15	13
	Coresearcher/member of the research team					11	10
	Recruitment					8	7
	Data analysis					10	8
Have you published in a peer-reviewed journal?	Yes					17	14
	No					6	6
Sharing of research	Conference oral presentation					16	13
	Conference poster presentation					16	14
	Non-peer-reviewed journal					7	4
	Report					3	1
	No					2	2
	Webinars					1	1

Continued

Table 2 Continued

	FG n=24	SS-I n=20	FG n=24*	SS-I n=20
Is research bound to job structure	Yes		14	12
	No		8	7
	Don't know		1	1
Is research required for promotion?	Yes		19	17
	No		4	3

*One participant did not complete the demographic data questionnaire.
FG, focus group; SS-I, semistructured interview.

one overarching theme as ‘the neurosurgical research potential in LMICs’ (see [figure 2](#)).

The local landscape

‘The local landscape’ was identified from contextual data describing the country in which participants resided. Descriptions were thick with comparisons to HICs.

It is very different here

Primarily the local landscape was understood as an inhibitor of the research process. Infrastructure to support research was often limited due to the sheer demand for care from a large population, poor doctor/patient ratio and a ‘survival first’ model of care.

Lack of time, resources, funding, electronic records and poor follow-up limited many from conducting research. While barriers to evidence utilisation such as lack of publications in native languages, literature behind pay walls and having to follow the practices of their seniors, inhibited many from applying contemporary research.

The one barrier that comes to mind, pronto, is the state of the medical records in much of developing countries. It is still paper-based, and located centrally. Makes retrieval of relevant clinical materials for research such a big, BIG hassle indeed. Another barrier: there is, usually, hardly any institutional support whatever for this sort of endeavours (CI, FG)

A sharp contrast was drawn between patients, treatments, diseases and injuries common in LMICs. Evidence developed in HICs was seen as problematic due to a lack of invasive monitoring, intensive care beds, advanced technology, CT and MRI scans. Data on improvisations and outcomes achieved were often absent. When research was conducted generalisability was still problematic due to regional and institutional differences in healthcare.

There is no way they can do A for all the patients okay, even C would be a miracle, they get more D and the problem with places like that is there’s no way they

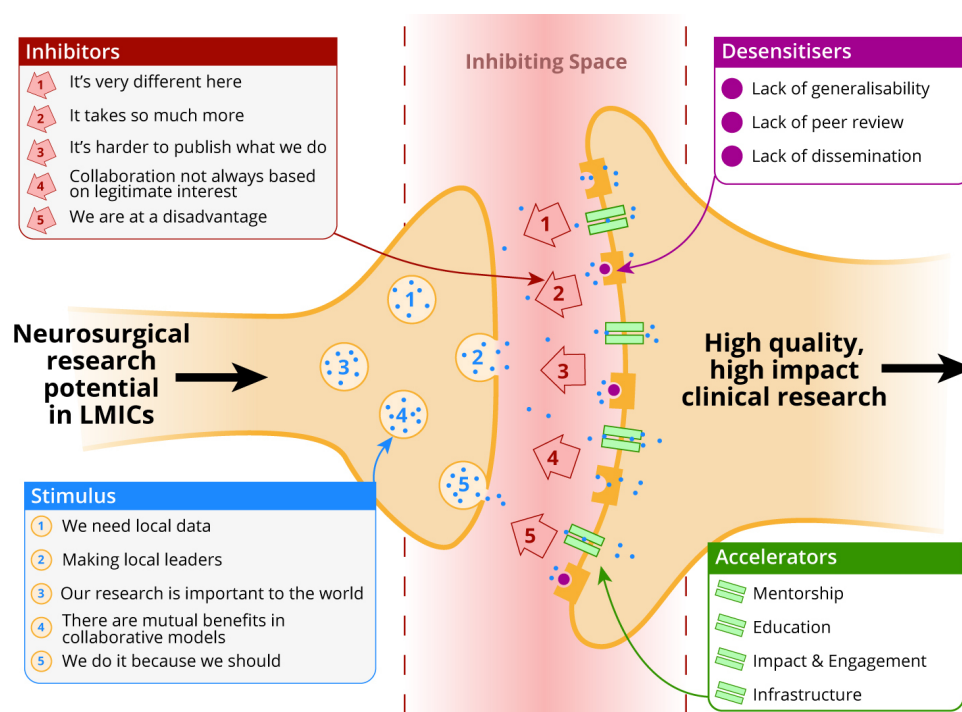


Figure 2 The neurosurgical research potential in LMICs. LMICs, low-income and middle-income countries.

can keep records either, they're so busy doing things that the record keeping is negligible or done by untrained people you know. So, if you want to go back and see okay how many people did well with B or C, you have no data (Q1)

The cost of healthcare and differences in patient literacy, comorbidity, compliance and follow-up were thought to influence treatment preferences and outcomes.

If we take vestibular schwannoma [...] for that purpose here we need to look into the patient economic status, and we need to check them whether they are able to come back for radiation therapy or not. Many of the patient population they say no we can't afford for radiation therapy. So in that case we have to remove the tumour completely. [...] whereas in the western countries, the surgeons there that you leave behind some tumour, some portion of tumour over the nerve. So that the facial function is preserved. So their priority is different (S1)

Where countries were considered unstable, governments perceived as lacking interest and universities broken, research was left unfunded, unvalued and understimulated.

We need local data

Paradoxically, the local landscape created a rich stimulus for research. Many felt there were important questions and local knowledge was seen as particularly important in identifying research priorities.

They need to see why this problem is happening and why there are so many cases in the low- and middle-income countries. What is the root cause for this? And they need to work on that (S1)

Many participants were driven by the lack of generalisable data and guidelines pertaining to their population. Indigenous efforts with local populations and resources were considered core to improving patient outcomes.

So, there are some things that we do, modification of technique or doing without something and then you still get a good outcome. And it would be good to share especially with other low- and middle-income countries who are in the same boat as us, that you can also get a good outcome if you do these things, even if you don't have all the bells and whistles of high-income countries (W1)

Research was seen as a tool to learn about, and advance neurosurgery through the systematic evaluation of practice and a means to reduce the demand for care. The use of registries was suggested by one participant as increasingly important for reliable data.

The only way to answer the questions that come to my mind is data data data (Q1, FG)

So, based on my experience, which I see, so, the research is a very important component of developing neurosurgery (B1)

The need for impactful research was evident in the accounts of the perceived benefits of local studies including improved use of resources, and a reduction in the economic burden of neurotrauma.

Creating capacity

'Creating capacity' was identified from participants description of how research by neurosurgeons was either constrained or facilitated.

It takes so much more

Participants shared vivid descriptions of the barriers they faced. The magnitude of workload and lack of available staff meant neurosurgeons felt overburdened, exhausted and 'burnt-out'. In the context of competing socioeconomic factors the lack of incentives was also a particular constraint.

If you have sufficient money, you have family who is satisfied, your children are going to go to school, your mother is healthy. You can do this. You can do research. You can travel. You can move. If you are hungry, your children are suffering. Your parents are suffering, and you are going to do research, it would be foolish (U1)

A perceived lack of, or problematic, funding was another core concern. Some felt there was rhetorical support, but funds were rarely available. Where funds were available, the process was considered complex and protracted. Some participants spoke candidly about the misappropriation of funds through corruption and lack of governance. Where there was no infrastructure to support research, research was heavily dependent on individual effort and personal funds.

We do research for free, and we have to pay out of our own pockets to hire research assistants and even pay for the paper and printer and photocopying services. All of our expenses are paid for by ourselves (W1)

Many participants described low engagement in research reducing opportunities to learn. Some also identified a toxic culture of nepotism and a failure of seniors to support and nurture research. In strong departmental hierarchies of power and influence, some juniors felt constrained in their ambition.

I think there is no benefit of conducting the research in our country. Nobody will bother to waste his time, money on research. This is a useless thing in our country. There is no fruit after such a struggle. So, nobody cares about doing research. Nobody bothers about doing the research (U1)

Many who wanted to do research felt there was a significant knowledge gap. Some participants described a lack of formal education and others said educational programmes that were available were insufficient in preparing them to do real research and lacked application. Therefore, most relied heavily on learning by

themselves. Lack of good mentoring exacerbated their perceived knowledge gap, leaving many with no map and no guide.

There is a lack of basic—of research methodology, and epidemiology, and biostatistics. There's lack of information about these topics (E1)

And of course for this to be possible we would need to have an overall better training in research from the beginning (K1)

This complex cascade of barriers meant research was seen by some as a luxury, the remit of others and for the privileged few.

Making local leaders

Participants emphasised the need to invest in local researchers and saw these as instrumental in bringing about change. Increased research capacity was only thought possible where there was a long-term commitment to create efficient researchers as well. Mentoring was considered crucial in developing such researchers. Where local mentorship was limited in skills, or by availability, participants looked internationally.

You have to make local leaders. You have to assist, you have to train. You have to give experience to the local leaders. So, you have to make the team of local leaders so they can do things to change because they know their environment of their country well (U1)

International experiences supported development of a research mindset, and access to good programmes of education were thought essential to robust research designs and advanced methodological knowledge. Access to flexible learning opportunities and open access were considered key.

I think such a programme would be one which, I think a quality programme should have a quality faculty, should have a faculty that is dedicated to long term sustainability of research (J1)

Participants also spoke about the need to increase community engagement, knowledge translation and local impact. Routes to funding facilitated neurosurgical research and hope was expressed that economic benefit would attract more government support and with it the ability to conduct more advanced designs.

Reach and impact

'Reach and impact' explores the perceived contribution of research by neurosurgeons in LMICs to the neurosurgical evidence base.

It is harder to publish what we do

Participants explored the difficulty of generating impactful research. High-impact journals were considered inaccessible with prohibitive publication fees. Lack of support for manuscript preparation was an important barrier and a lack of good English thought to mask

good-quality research. Reviewers were perceived as biased and lacked appreciation for LMIC practices.

Many are the times I have seen the manuscripts which have been like the reviewers have commented that the manuscript grammar, English grammar is very poor. And so it cannot be taken up for the review (S1)

Some participants reflected on the origins of such bias citing small samples, incomplete data, lost files and falsified data. While not experienced by all participants, falsifying data was thought more likely if practised by others or where research was a mandatory requirement. A culture of quantity not quality was thought to contribute to low-quality, low-impact studies. Descriptive and retrospective designs, case reports and case series were described as 'low-hanging fruit'.

I have seen people who just fake their entries, fake datas, and they're already biased with the conclusion, they try to fake the surgeries, they will try to fake the performance that they have failed, regarding the outcomes (G1)

Deep frustration followed, that having overcome barriers to research, publication in a high-impact journal was unlikely. Participants spoke about downgrading their ambitions publishing in low-impact journals, or not at all, and being vulnerable to predatory journals. Rejection was felt acutely, and without support and infrastructure for manuscript revision, cited as the reason many gave up.

You do realise that people are trying but again, there really are barriers. There really are systemic barriers that you really have to go through to publish in the high impact journals (O1)

Our research is important to the world

Despite the barriers, many participants had conducted clinical research. LMIC neurosurgical research was seen as essential to the advancement of neurosurgical practice in an international context. Differences between LMICs and high-resource settings made it even more important to communicate outcomes achieved.

One thing, it helps other countries with similar set up, for them to realise we can do this, even if you don't have all the resources available, this is what you can do. So, it helps guide other countries (O1)

Local populations and disease profiles meant LMICs were considered rich opportunities for research.

We definitely understand that in some LMIC or in most LMICs, you have these extreme different conditions that at some point will be important to investigate and also will be very important to show to the world (H1)

Some participants felt LMICs were gaining credibility and journals increasingly publishing their research. Where journal publication was not possible the impetus

to share findings through other means was strong. Routes such as conferences, team meetings and posters were all used alongside more contemporary routes such as social media, WhatsApp and preprint servers.

I use Twitter a lot. I feel that it has been very empowering for researchers in LMICs because it allows us to speak in the same platform as HIC colleagues. I get to see what global experts feel are important research, I get to curate them, and make recommendations as well. Would definitely recommend to others if they're not in it (O1, FG)

Collaborative inquiry

'Collaborative inquiry' examined working with local and international partners.

Collaboration not always based on legitimate interest

Examples of poor collaboration were predominately based in the past, but some were more pertinent to the present day, including imposing research questions or using LMICs to simply collect data. The equality of the LMIC/HIC relationship was questioned and perceived by some as favouring the HIC. This bias was observed in manuscripts where LMIC researchers were in less prestigious authorship positions.

Project-specific collaborations that missed the opportunity to generate research infrastructure or enhance research capacity left some feeling used and abandoned. Lack of local collaborations were also thought to exacerbate isolation and lack of regional growth.

That again would depend on the researcher from the high-income countries, how much he is willing to make the LMIC researcher an equal or almost equal rather than making them just a data collection person (Q1)

HIC researcher motivations to use the LMIC as a means to their own ends was considered by one participant as 'colonising in the digital age' (O1). While improvements were described, tokenistic authorship still existed.

There are mutual benefits in collaborative models

National and international research collaborations, communities and hubs were seen as ways to build sustainable research capacity and scarce resources meant multi-institutional efforts were valued. Collaborations provided resources, funding, manpower, expertise and mentorship to support study design, implementation and manuscript writing. Exchanges and scholarships were also prized.

Creating research hubs for education in research and publishing skills will be a way to start. Once you develop the collaboration adding more local institutions and players into the process will expand the knowledge transmission. Putting peers to work together [...] with faculties from HIC and LMICs will create a unique opportunity (H1)

There was a sense of pride associated with international and national collaborations and it was hoped increasing governance would improve encouragement for research. As such, collaborations had the potential to improve research culture and local impact.

It turns out it's a win-win situation for everybody concerned because those who are from far flung areas too are not going to be research minded. By the time they've got contact with the people from ivory tower they get to share ideas, right? They get to share perspectives, they get to see how little things maybe done differently and they are happy (C1)

While one participant struggled to identify any HIC benefits, benefits to the HICs were most notably identified as access to a larger sample size, increased burden of disease, the prevalence of neurotrauma and unique opportunities to study disease.

Yeah, I think that sending people to lower income countries, it is a thing because we had a very raw scenario when it comes to problems of mankind. Very common problems of mankind, unexplored scientifically wise problems of mankind that are important matters for millions of people (L1)

Some also felt because HICs influenced standards for research and publication they had a moral responsibility to liberate talent and create opportunities for LMICs. While independence in research was valued for some, collaborations were still instrumental in achieving growth.

Growth and sustainability

This final theme considered the overall growth and sustainability of research by neurosurgeons in LMICs.

We are at a disadvantage

As relative newcomers to the global neurosurgical research scene LMICs were considered disadvantaged. HICs were described as more dominant, powerful and influential. One participant described LMICs as the 'under dogs', and dominance was perceived by some as detrimental to the global evidence base.

Dr [M1] is saying here is that for example tranexamic acid is something that we do, that we have been doing for the past 10 years and right now it has been published as a 1A class evidence (L1_M1)

Regional, institutional and economic differences also left some with less ability to develop research knowledge and conduct impactful research. Those able to work in institutions which valued research were considered fortunate.

But if you look at the bigger picture, let's say, department shares and so forth, well, I'm lucky to be working in an academic institution where people do see the value of research (W1)

Where research was for personal benefit and knowledge and skills not used to support others, this had a detrimental impact on sustainable research capacity.

We do it because we should

A lack of generalisable evidence/guidelines and a desire to improve patient care provided a compulsion to research. Where research offered little tangible benefit, participants spoke about personal gratification, single endeavour and research as a mandate not a choice. Research was a means to survive in an intense environment or to thrive, to extend practice, reach and impact.

Dr [M1] is saying that financially wise and economically wise it is absolutely under-assimilating to keep up with the production, keep up with science. By admitting that we reached the end of the line and we're not capable of doing anything it's something we are not up with. We keep the struggle (L1_M1)

Incentives for research were considered important and while mandatory research did not always drive high-quality research, it was also credited with improving attitudes and exposure to research.

For example, in the last few years, just to give you an example, they now require trainees in the [...] to complete an original research or to be able to present. So, before, maybe go back ten years, nobody cared about research. I don't know if it's a good thing or a bad thing that they now require these things (O1)

While perception of growth was different, research in LMICs was thought to be gaining momentum. Inspirational mentors, a new generation of neurosurgeons, electronic records, online learning, increased access to international literature and social media were credited with improving research culture. Time was necessary to embed change, the evolution of mindset and growth of neurosurgery had brought additional opportunities, manpower and enthusiasm. Increased research capacity was thought to contribute to improved credibility, reputation and global respect.

Accelerators and desensitisers

Accelerators were factors to improve the quality and impact of research. Mentorship and education were particularly important to conducting locally relevant advanced research. Increased impact and engagement were also required to change attitudes towards the value and importance of research. Infrastructure, including encouragement from governing or institutional bodies, was considered essential in advancing neurosurgical research.

Desensitisers were issues that jeopardised the impact of research by neurosurgeons. Lack of generalisable LMIC research reduced its ability to affect care in other regions. Preprint servers, predatory journals and other forms of dissemination without peer review may also reduce global impact. Good studies conducted but not

disseminated prevents this knowledge from advancing global neurosurgery.

DISCUSSION

This study is the first to document both inhibitors and stimulators of research by neurosurgeons in LMICs which emphasised the importance of regional context. When reflecting on public health challenges Rabbani *et al*²⁹ stated 'LMICs are layered with health burdens rooted in complex political, economic, social, environmental and demographic realities'. Our findings mirror these complexities but illustrates how these may both constrain and liberate neurosurgical research in LMICs.

While neurosurgery is in its infancy in many LMICs the development of relevant guidelines is increasingly important.⁸ However, LMICs still do not have sufficient evidence to inform neurosurgical practice and improve health.³⁰ Neurosurgeons in this study understood that research was integral to improving health outcomes^{10 31} and for many drove them to conduct research to affect care. This moral imperative is important as neurosurgery embeds itself in LMICs.

Weak research systems have been identified as the antecedent of reduced research capacity²⁹ and described as 'enduringly problematic'³⁰ (p.2). Despite limited resources many of the neurosurgeons in this study were engaged in research. However, conducting advanced impactful research took infrastructure and funding. Funding is a key issue in resource-poor regions and spending and research priorities are a complex issue.²⁹ In the context of advancing neurosurgical technologies funding becomes even more important and more must be done to increase investment in research.⁸

Prioritisation of journal publication over improved policy and practice are considered poor incentives to impactful research.¹⁰ Neurosurgeons in this study were aware of both favourable and unfavourable consequences of mandatory research; increasing capacity, while increasing low impact designs. While compulsory research is not universal, consideration should be given to appropriate incentives in LMICs. Unintended consequences of incentives, such as international opportunities, may exacerbate local 'brain drain'¹⁰ where capable health professionals leave the public sector for HICs or private practice where remuneration is better. Therefore, the challenge may be in balancing engagement, enthusiasm and drive with incentives to return this knowledge to local practice.

In this study, impact and engagement were seen as specific accelerators of research by neurosurgeons to affect positive change of those within the profession and the communities they serve. LMIC policy makers were often portrayed as sceptical about research. Yet, neurosurgeons emphasised its role in directing resources to areas of greatest need.^{8 29} Improved mechanisms for feedback of research findings through community engagement

may be beneficial^{3,32} and models to facilitate this should be evaluated.

Accessibility to research is important if those in LMICs are to use and engage with it. In our study, evidence behind pay walls, journal rejection of manuscripts and high processing charges meant increased use of preprint servers, predatory journals, lower-impact dissemination and online platforms to share ideas. While the internet has led to a ‘cross-fertilisation and diffusion of ideas’,³³ through legal and illegal means, the impact of disseminating evidence without peer review on the impact and credibility of LMIC research needs consideration.

Collaborations are key to the success of research in LMICs.^{31,34} Findings of this study show a positive attitude towards international, and national, collaborations and that such collaborations lend themselves to the development of long-term relationships beyond individual projects. Yet, neurosurgeons in this study felt disadvantaged in advancing global health and recognised that HICs tend to have more global influence.³³ Power relationships can affect capacity development³⁰ and increased contextually relevant research more likely to have local impact is key.³

Vasquez *et al*³⁵ suggested HICs approach collaborations from a position of humility and solidarity and not ‘transfer of skills across a boarder’ (p.S120). Despite this, collaborative research is often led by HICs³⁰ and authorship commonly reflects this dominant position. Partnerships that favour one side decrease morale and research outcomes.²⁹ Our study illuminates this complex issue and extends this tension to interdepartmental authorship in a local context. Transparent and fair authorship attribution could perhaps be part of good practice guidelines with more opportunities for meaningful LMIC authorship under guidance and support. Such actions may go some way to increase evidence ‘from’ and not ‘on’ LMICs. Recommendations from this study are summarised in [box 2](#).

Study limitations

This study was limited by its small sample, under-representation of low-income countries and over-representation of South Asian countries. Continents, countries and regions are very different in LMICs, therefore, the vast heterogeneity evident in LMIC populations and the views of those not interested or engaged in research remains largely unexplored. In addition, the ‘neurosurgical research potential’ was only explored from the perspective of neurosurgeons and we would encourage wider understanding of this research potential from the perspective of other neurosurgical professional groups. Furthermore, the findings of this study are influenced by the lens of lead author. Further studies led by those within LMICs are recommended.

Conclusions

The geographical, political and population complexities make research endeavour challenging for neurosurgeons in LMICs. Yet in spite of, and because of,

Box 2 Study recommendations

- ▶ Evaluate the specific effects of mentorship, education, engagement and improvements in infrastructure to high-quality clinical research outputs in low-income and middle-income countries (LMICs).
- ▶ Carefully examine the relevance and generalisability of LMIC research to other LMIC contexts.
- ▶ Understand if and how publication without peer review impacts on the quality and impact of LMIC research.
- ▶ Explore ways that neurosurgeons in LMIC can be actively encouraged to engage in research and be supported through manuscript preparation that allows good-quality research to reach an international audience.
- ▶ Create more opportunities for high-quality open access educational materials written in collaboration with LMIC researchers.
- ▶ Work in collaboration for the benefit of global neurosurgery committing to long-term relationships that liberate talent and release potential.
- ▶ Commit to transparent and fair authorship attribution and develop opportunities for meaningful LMIC authorship under guidance and support.
- ▶ Use opportunities to increase community engagement and participation in research.

these complexities LMICs provide rich opportunities to advance global neurosurgery. More studies are required to evaluate the specific effects of accelerators of research conducted by neurosurgeons and to understand the effects of desensitisers on high-quality, high-impact clinical research.

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Contributors PJH and AGK conceived the research idea. CJW, AGK and BGS designed the study with TB, INE, CK, MMK and DJFS suggesting amendments to the protocol. CJW then collected and analysed the data with support from BGS. CJW and BGS wrote the first draft of the manuscript for publication. INE, MMK, PJH, AGK, DJFS, WSP and AF critically reviewed the manuscript and provided detailed feedback. All authors are accountable for the work.

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