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The application of medical ethics in the developing countries – A neurosurgical perspective

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ABSTRACT

Introduction: Neurosurgery is one of the rapidly evolving specialities of medical science, where the neurosurgeons have to provide evidence-based interventions in life threatening conditions maintaining the ethical standards.
Research question: This narrative review sheds light on the current hindrances of the ethical aspects of neurosurgical practice in low and middle-income countries (LMICs) and provide some feasible solutions for future.
Material and methods: A literature search was conducted using PubMed, Scopus and ISI web of knowledge focused on articles in English with the words "medical ethics" together with the words "neurosurgery", "ethical practice", "low and middle-income countries", "surgical innovation", "randomized clinical trials" and "outcome" alone or in combination.
Results: Due to the lack of neurosurgeons and essential infrastructures in LMICs, the practical application of medical ethics is more complicated in the field of neurosurgery. Main obstacles to conduct preclinical and clinical research in the LMICs are the lack of proper ethics committees, quality data, trained manpower and sufficient research funding. Implementation of randomized clinical trials (RCTs) is also difficult for the neurosurgeons working in LMICs.
Discussion and conclusion: To improve the situation, socio-economic development, including educating the citizens of these countries about their rights, functional regulatory bodies like medical and dental councils, teaching the neurosurgeons about the internationally recognized medical ethics, quality control regulations by the ministry of health and welfare, and more funding for the health care sectors are urgently needed. Global collaboration is needed to help the LMICs to provide their patients international but "customized" standard care.

1. Principles of medical ethics and their importance in neurosurgery

It is not only important to treat the illness, but also how we do it. The role and task of medical ethics is to delimit the best ways by which the treatment is done maintaining its legal boundaries. It is essential to treat the patient in the way that is right for them. To do this, we need to provide the right amount and quality of information taking into account the level of literacy of the local people. While this is true for healthcare

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Abbreviations

LMICs	Low and middle-income countries
BASS	British Association of Spine Surgeons
ICU	Intensive Care Unit
RCT	Randomized Clinical Trial
WHO	World Health Organization
WFNS	World Federation of Neurosurgical Societies
EANS	European Association of Neurosurgical Societies
NIHR	National Institute for Health and Care Research

in general, in sensitive areas such as neurosurgery, where a small mistake can lead to a massive disaster leading to death, severe disability and/or legal issues including massive compensations, this is a vital issue in daily clinical practice as well as in research. Therefore, it is of paramount importance that patient knows what is happening to them and live with the opportunity that is given by the principle of respect of autonomy. However, as will be discussed in the paper, currently, this might not be the case in the low and middle-income countries (LMICs).

Medical ethics is a field of applied ethics which was found on a set of four basic core principles.

- Respect of autonomy
- Beneficence
- Non-maleficence
- Justice (Gillon, 1994).

And there are two additional building blocks in medical ethics that are coming to the fore recently.

- Dignity and
- Honesty

The role of autonomy is to provide the information and opportunity for patients to make their own decisions regarding the treatment. Autonomy is an indicator of general wellbeing since a healthy individual is able to take a rational decision. However, "respect for autonomy" could be different from one culture to another culture. Beneficence is related to the best interest of the patient. Nonmaleficence originates from the Latin phrase, primum non nocere, that indicates – do no harm (Page, 2012). Under this principle, a clinician can prescribe only the interventions which are not lethal for the patients. However, the explanation of the risks and benefits ratio is important from these aspects since there are such medical conditions where urgent treatments need to be provided without being sure of the outcome. The fourth principle, justice, indicates that during offering the treatments and distributing scarce medical resources, a clinician should try to be as fair as possible and should be able to justify the actions in each single situation (Gillon, 2015). Dignity and honesty, that have been introduced as another two kind of principles of medical ethics, are also two core components of values-based medicine (Ammar, 2014). Here, dignity indicates the respect of patients' rights and recommends that the patient should be an integral part of the decision making for the full management of the disease that they are suffering from. Honesty emphasizes trust and truthfulness of the clinicians towards their patients. Despite any unfortunate situation, a physician or surgeon should elaborate the condition to the patients and/or their next of kin, which would minimize misunderstandings, ensure transparency and openness. Note that considerable variation in the interpretation of definitions regarding the threshold for duty of candour in clinical practice has been demonstrated (Basu et al., 2020).

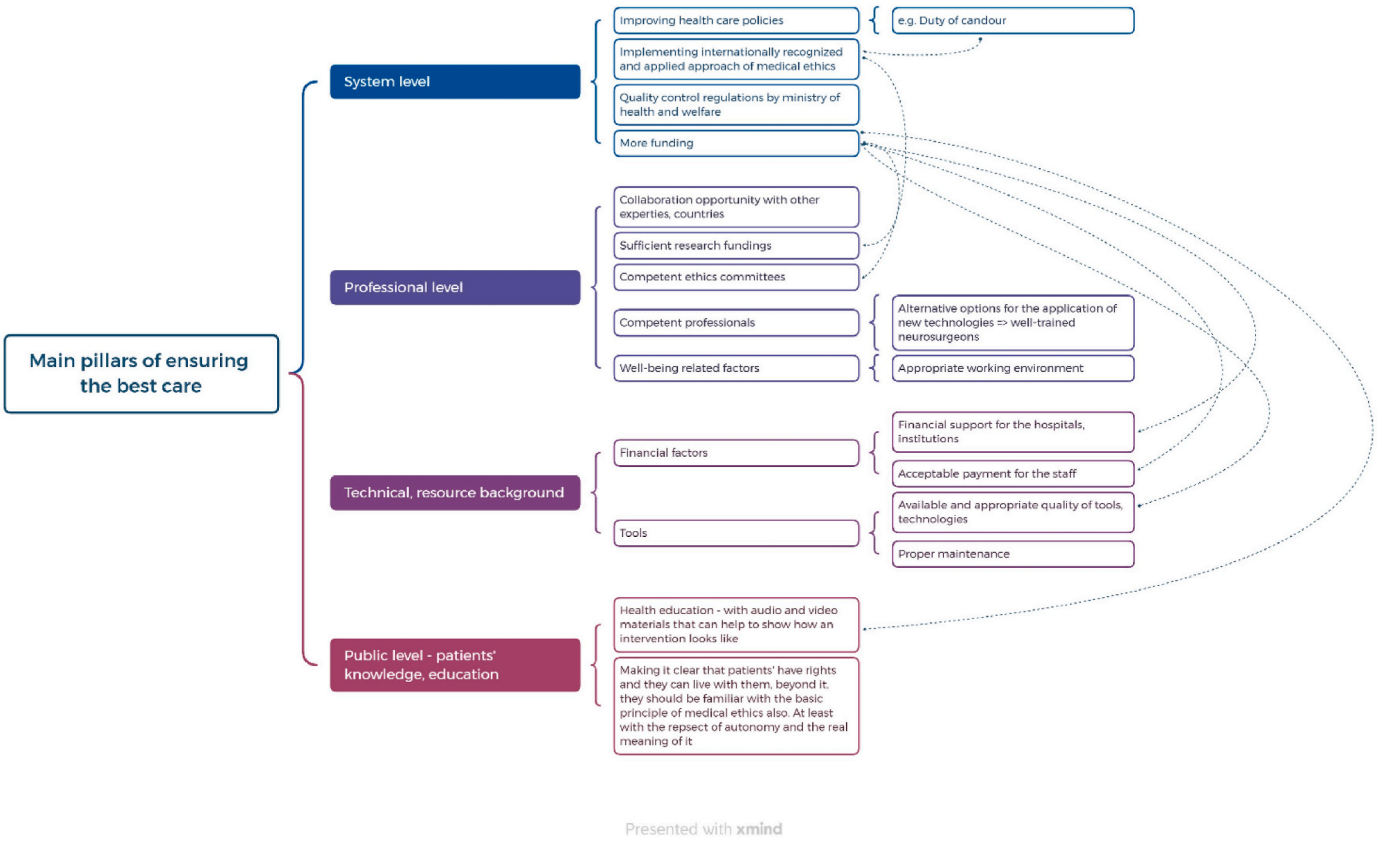

Fig. 1. The main pillars of ensuring the best care.

2. Ethical implementation in medical service

The aforementioned six vital principles could be difficult to apply in similar fashion in the different parts of the world, since the socio-economic indicators are different. There are basic pillars of medical ethics, and there are different governing bodies that define medical ethics for the different fields of medical science. According to the current concepts of evidence-based medicine (Esene et al., 2016) and values-based medicine, it has been advocated that, due to cross cultural ethics, there are limited standardized ethics that could be applied to people of all societies (Ammar and Bernstein, 2014). Depending on different religious beliefs, cultures, and healthcare infrastructures, neurosurgeons need to adjust their expertise to provide the patients the best possible available treatment within a frame of ethics and values which appreciate their culture and keep their dignity. Given that neurosurgery influence the critical melting point between life and death, neurosurgeons have the responsibility and challenge of rational decision making – ensuring the best care of the patients considering and respecting the values of the patients and their families. Although the basic medical education for the health care professionals are similar due to the advancement of science and technology, the applications of the medical knowledge could be different form one culture to another. In some large countries value systems have been strongly influenced by different religions, for example, Hinduism in India (Ammar, 2014). The fundamental basis of ethics arises from the Hindu belief that all creatures are part of the divine spiritual power. Before the colonial era, the medical science of the Indian subcontinent was significantly driven by two ancient codes of life, Ayurveda and Charaka,(Francis, 1996) describing the science of life and the objectives of medicine for life, respectively. Both ancient beliefs described that the principle of a physician is to cure a patient as a whole for bringing physical and mental health. It has been described that the health care system is designed to maximize comfort and wellbeing for the suffering patients, however, some principles are strongly influenced by different spiritual beliefs (Worthington and Gogne, 2011). The ancient beliefs are also manipulated by the health literacy rate of the corresponding area of the country and the attitude of people towards the health care system. During the colonial era, modern health science was introduced in South Asia (Mushtaq, 2009), though there are still difficulties to apply the medical ethics sufficiently to ensure the best treatments for the patients, as well as to keep a transparent relationship between the health care professionals and the patients. Another prominent example of cultural influences on ethical practice is the history of traditional Chinese medical ethics rooted in Confucianism. In such care, patient autonomy was not a valued principle (Qiu, 1988). However, with the advances of science, the first Chinese bioethics association was found in 1988 (Xu, 1990). Still there are strong sociocultural factors that play important roles in the ethical implementation in medical services around the world (Qiu, 1991). Besides the proper utilization of the internationally valid building blocks of ethics in daily clinical practice, another important issue is the application of the principles in scientific research.

From the aspects of the practical application of the medical ethics, a number of issues, for example, informed consent, patients' right, confidentiality, conflict of interest, unnecessary investigations and treatment, hospitalization, unethical advertising, and proper use of new innovative technologies, require justifiable considerations. Neurosurgery is one of the rapidly evolving specialities of medical science, where the neurosurgeons have to keep the quality of up-to-date care and provide evidence-based interventions in life threatening situations, in order to avoid medicolegal issues.

From neurosurgical perspective, it is extremely important to inform the patient about the pros and cons of the procedure thoroughly, as neurosurgical procedures are difficult to understand. It is more so in a developing country with low rate of health literacy.

3. Problematic moral and legal rights

3.1. Informed consent related to treatment

Informed consent is an important section of the medical practice (Bernat and Peterson, 2006), though it could be influenced by the different factors in the developing countries, for instance, in LMICs where the health literacy rate is not satisfactory. Patients seeking treatments still believe that the health care professionals could decide the best for their outcomes (Jaeger et al., 2018). This is the typical characteristic of paternalistic physician-patient relationship, when the patients do not get or want to get enough information. This is because of the lower level of education of the patients. The trend is changing in big cities where cultures are driven by education, development of the private health care facilities, insurance companies, and the development of technology. Nevertheless, it is difficult for many doctors working in LMICs, especially those who were trained abroad, to counsel the patients allowing the patient with full autonomy to accept or reject the treatment options. They have to adapt to the local circumstances, not only in case of professional factors, but also in case of patient-related ones. For example, sometimes difficulty arises for a neurosurgeon working in an underdeveloped area to obtain proper informed consent to operate on a patient who needs a time-critical emergency neurosurgical intervention, especially, if the patient is not educated enough to understand the risks of the surgical procedures. If the patient deteriorates, there is a huge possibility that the surgeon would be blamed by the society for the negligence wholly or partly to provide the best care for the patients (Nandimath, 2009).

3.2. Informed consent related to research

Besides the modern treatments, nowadays many multicentre based pharmacological and surgical trials have been introduced in the LMICs, which are funded by different wealthy nations or international organizations. It has been reported that, on several occasions, the trial participants gave informed consent without understanding the impact of the clinical trials. Furthermore, many of the participants were not aware of the ethical considerations of such trials (Alemayehu et al., 2018).

3.3. Malpractice issues

Essentially, it is high time to take the necessary steps in order for patients to understand their rights and responsibilities in the health care sectors. Additionally, the health care professionals should be able to explain the consent issues having respect to the cultural values. Since the probabilities of morbidity and mortality are high in neurosurgical practice, depending on the types of neurosurgical conditions and the available timely treatment facilities, it is an utmost responsibility of the neurosurgeons to develop the premium skill, namely, good doctor-patient relationship.

In a developed country like the UK, neurosurgical practice remains among the highest malpractice risk specialties. Mukherjee et al. described the highest median pay-outs were for claims against faulty surgical technique (£230,000) and delayed diagnosis/misdiagnosis (£212,650) in their article published in 2014 (Mukherjee et al., 2014).

Similar system is lacking in many of the developing countries where the informed consent is not 'fully informed'. Chester vs Afshar case (Austin, 2021) in the UK flags the importance of informed consent even further. The British Association of Spine Surgeons (BASS) introduced the '3 legged stool' format of spinal surgery (Powell and Hutton, 2016) which is also very comprehensive and needs to be introduced to make the patients and their relatives fully aware about merits and demerits along with physical, mental and economic consequences of a procedure.

In a developing country reality, the socioeconomic inequalities and the population's low awareness of their rights could explain the malpractice cases (Leonardo and Lucas, 2020). A recent systematic

review and meta-analysis reported that spine claims had a significantly higher rate of filed malpractice claims, while cranial malpractice claims were associated with higher litigation compensation (Iqbal et al., 2024).

3.4. Confidentiality

Confidentiality is a vital issue of the medical science, though this might be different in the LMICs. Generally, due to the poor social welfare system, different family values compared to the western world and the lack of health literacy, patients could be accompanied by several close relatives or friends when they seek hospital treatment. According to the internationally valid medical ethics, the overall process, including the clinical history taking, diagnostic procedures, diagnoses, and treatments should be between the treating medical team and the patients, unless the patients are not healthy enough to give their consent (Gray, 2010). Family involvement might differ, depending on the patient's culture. Considering this, it becomes difficult for the treating neurosurgeons to keep the same international standard of ethics in some situations. Improvement of the health care system could promote development and modification of the situation, in order to inspire citizens to trust the clinicians.

It is also necessary to make it clear that regardless of culture, country and social level, it is important to have a good doctor-patient relationship and the neurosurgeon to have to act ethically in all cases, explaining in a simple way so that the patient and his family understand the disease, the risks and benefits of surgery.

There is a tendency of the surgeons to publish their nice pieces of surgical work on the social media in the current days and age being influenced by the strength of those. This practice has got serious potential to breach the confidentiality. This needs to be addressed by obtaining proper consent and blurring of the face or covering the part of the face to maintain the anonymity and confidentiality of the patients.

Sometimes it is necessary for medical institutions to prohibit postings or give instructions on how photos or videos can be used in lectures or social media, preserving the patient's confidentiality and dignity.

4. Research, implementation, and limits

4.1. Reasons of higher risks in neurosurgical innovation and implementation

Furthermore, with the advancement of the medical science, different types of new diagnostic aids have been introduced to the developing countries. Neurosurgeons trained abroad might face problems to optimally utilize the equipment. This stems from various reasons, including differences in practice, limited availability of skilled staff to ensure the best maintenance of such advanced equipment, moral issues of the clinicians, and the quality of manufacturing companies. It has been reported that unnecessary investigations, for example, imaging and other laboratory tests, which were prescribed by the clinicians, were not beneficial for the patients (Brownlee et al., 2017).

In this era of evidence-based management, two issues require immense importance, i.e., efficacy and effectiveness. Efficacy refers to the ability to produce desired effect in expert hands, whereas effectiveness is the ability to produce the desired effect in normal usage. It is important to develop good and truthful communication between the neurosurgeons and the patients and their families, regardless of predicted outcome, which is also facilitated by the health care systems to ensure the best care (Kaba and Sooriakumaran, 2007). Ethical issues in neurosurgical innovation is a contradictory concern, because the risks of new procedures are unknown at the outset (Angelos, 2013). This issue is also related to the learning curve of trainees. Whether to discuss the lack of a neurosurgeon's experience of a new procedure with patients is not completely known – a future challenging topic to be explored from the ethical perspective. Surgical progress and surgical benefit are interrelated terms and are closely associated with the ethical practice of medicine (Broekman et al., 2016). Although previously surgical benefit was used to be defined by surgeons on the basis of increased longevity or decreased morbidity and mortality, to date, it is considered to be defined relative to the patients' values. The question whether the patient will benefit from an operation depends on the patients as well as their families' goals and values. With the advancement of neurosurgery, outcomes are no longer evaluated by simply reporting the reduction of morbidity and mortality (Maas et al., 2017). Importance of quality of life and patient reporting in assessing the surgical advancement are an integral section of medical ethics. The professionalism of neurosurgeons is required to ensure that newly developed treatments are not necessarily improved, as sometimes automatically expected. Neurosurgeons must carefully gather the data to determine if patients truly benefit from any surgical innovation, remembering the fact that new technology benefits patients and not just neurosurgeons; this is the epitome of professionalism (Austin, 2021).

Modern neurosurgeons have to rely on rationality – no matter the level of sophistication of a certain operation, if there is any known doubt in the efficacy of the operation, a sensible neurosurgeon should have the ability and confidence to avoid the surgery (Goel and Kothari, 2006). The most important quality of a modern neurosurgeon is to be able to decide when not to operate. Neurosurgeons are often confronted with situations where they have to make life changing decisions. Uncertainty of outcome is an integral part of their profession (Umansky et al., 2011). Taking risks utilizing their practical experience and wisdom should often cover for the lack of scientific evidence. Due to a shortage of class one evidence, it is never possible to determine whether actions are completely right or wrong. However, even though it might not have effective outcome, without these risks, numerous lives would not have been saved by the neurosurgeons. Despite the outcome, neurosurgeons should be able to take full and honest responsibility of their actions (Goel and Kumar, 2015).

There are a plenty of randomized controlled trials (RCTs) with level 1 evidence in neurosurgery. Those need to be taken into account for a safe delivery of neurosurgical intervention regardless of location in the world. The neurosurgeons in the developing countries should bring those into practice. Beyond this, the next tables (Tables 1 and 2) try to make it more explicit as to why the modern view of medical ethics is a desirable approach that should be followed to enhance patient care.

Table 1 contains the most relevant factors that apply differently within the two compared economic areas. The contemporary approach, which emphasizes patient autonomy and preferences, is often unfeasible in LMICs due to unfavourable conditions and previously discussed factors. In many ways, LMICs exemplify the traditional model of medical ethics, where the physician's decision is paramount and seldom challenged. This is largely because patients are not engaged in the decision-making process, nor are they adequately informed about their condition, the associated risks, benefits, or alternative options. Although there is generally an intention to involve patients throughout the process (aside from significant business-driven influences), the socio-economic and socio-cultural context is often insufficient to implement this effectively. These are illustrated in Table 2.

Tables 1 and 2 contrast the ideal patient involvement in treatment-related decision-making processes, as represented in the high-income

Table 1
Key factors influencing the application of moral principles and decision-making in LMICs and HICs.

Factors	LMICs – (view of traditional medical ethics)	HICs – (view of modern medical ethics)
Informed consent	Simple consent, rather formal and not well explained	Appropriate patient information: quality and quantity
Physician- patient relationship	Paternalistic	Collaborative
Confidentiality	Problematic	Well-regulated and obeyed

Table 2
Reasons and consequences of the disparities between LMICs and HICs.

Reasons:	Low health literacy < - influences all the malfunctioning factors	Higher health literacy
	Different interests: business reasons (e.g. clinical trials) -><- patients' interest Vulnerability	
Consequences:	Lack of appropriate patient information	Given opportunity for the best care
	Lack of the chance of implementing the principles of medical ethics, like respect of autonomy.	

countries (HICs) columns, with the underlying reasons and resulting outcomes, particularly in the context of neurosurgery.

5. System and professional issues

5.1. Ethical practice of drug therapy

The pharmaceutical industry is one of the growing industries in the LMICs. Apart from the national investment bodies, many multinational companies are successfully doing their business in this sector. Unfortunately, it has been found that many drug companies also inspire the clinicians to prescribe unnecessary medications for making profits. These harmful activities corrupt the moral values of the clinicians (Greenhalgh, 1987). Different important bodies, like the medical associations, pharmaceutical ethics committees or quality control organizations, are not well established and properly functional in the LMICs. Therefore, vital medications like antibiotics could be bought without any prescriptions. This is one of the reasons for the antibiotic resistance, which is at this moment a significant problem around the world (Ayukekbong et al., 2017). Poor ethical values of the physicians, non-functional drug control authorities, poverty, and excessive population are the main factors behind such situations. Besides these, with the rapid growth of the private healthcare organizations, there is an unhealthy competition between the hospitals to attract the rich people for better and up-to-date health care. Given that neurosurgeons treat a lot of cases that involves conservative treatment, it is vital for them to avoid any unethical practice of prescribing drugs. Advertising the consultants working in corporate hospitals are often unethical according to the internationally recognized medical ethics (Francis, 1996). The legislative organizations, like medical and dental associations and the ministry of health and welfare, could only improve the situation by the proper application of the laws to ensure the qualities of the health services.

5.2. Limited resources and scarcity of well-trained neurosurgeons

Almost 22 million additional neurosurgical procedures are needed in LMICs each year to meet the current demand (Tropeano et al., 2019). Unfortunately, in many of these countries, there is a vast shortage of qualified neurosurgeons. Considering the populations of these countries, the number of trained neurosurgeons is often not enough. The most striking lack of access to neurosurgical care is among countries in sub-Saharan Africa, followed by East Asia and Pacific region (Punchak et al., 2018). Many neurosurgical centers of the LMICs have limited resources to provide the best standard care, and as a consequence, poor quality of care could lead to unfavourable outcome, regardless of the excellence of the neurosurgeon. Maintaining proper medical ethics becomes challenging in such circumstances. Moreover, many trainee neurosurgeons are not well paid.

5.3. Unequal distribution of neurosurgical facilities

There is a big difference between public and private hospitals in many parts of the world. Patients with insurance and well-off patients can buy the best available treatment, but those who are not insured and receive health care facilities provided by the government. Such conditions are common in the LMICs and this even true for many centers in the US. (HoffmanParadise, 2008) In case of neurosurgery, the scenario is much more complicated.

The difference in public sector and private sector differs in different countries. For example, in the UK most of the complicated operations are done in public hospitals (NHS) whereas the private hospitals are better for reducing the waiting time in relatively less complicated cases. The obvious higher cost for the patient and the potential risk of complications, which may be difficult to manage in private hospitals are the key factors for pushing those cases to NHS.

In the LMIC countries like Bangladesh, India or Pakistan, some private hospitals have developed the logistic support to carry out the complicated surgical procedures. Due to relative lack of implementation of ethical consideration and accountability, private practice is not associated with high indemnity or increasing indemnity after a complication. Hence, the practice is different.

In some of the LMIC countries there are private hospitals with all essential tools to perform neurosurgical procedures, however, there is a discrepancy among the hospitals. Some of these have surgical tools and technology, for example, operating microscope and allied materials needed, but on the other hand, some hospitals do not have clips, haemostatics, a suitable drill, using the old Gigli saw or even have a bipolar that works properly. Lack of equipments can limit the abilities of the neurosurgical team to perform complex procedures. In addition, the lack of neurosurgeons in public hospitals can overload the existing team or not having these professionals in an emergency can put the patient at high risk. These unequal distributions of neurosurgical facilities create obstacles in the proper application of medical ethics and turn the field more challenging for the practicing neurosurgeons (Ismail et al., 2023). Such situations also reflect the importance of training for the health care professionals regarding medical ethics and its application in different set ups, as well as the equal importance of real-life applications of the values and overall socio-economic development of the developing world.

Sometimes in LMICs there are situations of non-payment for public hospitals, making it impossible for all employees to receive payment, including neurosurgeons, nurses etc. which can often cause crises or manifestations with interruption of services, which limits the neurosurgeon to provide adequate assistance to the patient, either due to the interruption or the impossibility of the hospital making the purchase of appropriate equipment. Finally, for the proper functioning of a neurosurgical department in a hospital, a synchronized work of a large team of employees is necessary, ranging from the administrative area to intensive care units. For instance, in places of Latin America and South Asia, the lack of resources and tools in public hospitals creates risks for neurosurgeons, who sometimes have to find a way to operate patients and save their lives. The lack of Intensive Care Unit (ICU) space is a reality in many countries like Brazil, Cameroon, and Bangladesh. Budget constraints may also affect the ability to purchase new equipment and to train staffs. In distant regions, in the interior of the states, transporting patients and the logistics of bringing supplies can be challenging as well (Mediratte et al., 2021).

Difficulty to follow international standards arises when highly qualified clinicians are appointed in peripheral small hospitals with limited availability to the necessary equipments and facilities (van den Hombergh et al., 2009). Unfortunately, the quality of care significantly differs in different parts of the LMICs. In smaller or peripheral cities, there are no resources or neurosurgeons to take proper care of the patients. Therefore, the patients are usually transferred to larger cities when they need neurosurgical care. Sometimes even in capital cities there are not enough resources in some of the hospitals to perform

surgery and the neurosurgeons struggle with adversity to save a patient's life (Maas et al., 2017).

5.4. Hindrances of conducting clinical research

Main obstacles to conduct preclinical and clinical research in the LMICs are the lack of proper ethics committees, quality data, trained manpower and sufficient research funding, that are the pillars for any research activities (Masic et al., 2014). Nowadays, the young neurosurgeons strive to conduct scientific projects and initiate new international collaborations. But the initiation of such projects is hindered due to inadequate evaluation and support from ethics committees. Without following the international standards, the studies would not be scientifically acceptable to publish in the internationally peer reviewed journals (Peh, 2007).

To encourage those in the developing countries, they should be included in multi-centre research trials.

5.5. Application of randomized clinical trials in neurosurgery in low resource settings

Due to different practicalities, only about 8% of class 1 randomized clinical trials (RCTs) are conducted in the low resource setting countries (Servadei, 2023). High quality evidence produced by these neurosurgical RCTs could be hardly replicated in the LMICs. For instance, the RESCUEicp study showed a significant clinical improvement in the patients located in the surgical arm at 12 months and 24 months after injury (Kolias et al., 2022). Unfortunately, many countries in the worldwide cannot provide intensive rehabilitation, cranioplasty, and management of post-traumatic hydrocephalus for such a long time after the trauma. Recent studies have shown that in many settings mortality at discharge could be the best outcome data available in difficult environments (Clark et al., 2022). Thus, there is a substantial disparity between HICs and LMICs in the number of published RCTs and their applications (Griswold et al., 2020). A new era of collaboration should be opened to share knowledge and to apply the research findings appropriately considering the resource settings.

5.6. The role of international collaboration

Different international neurosurgical societies, for example, the World Federation of Neurosurgical Societies (WFNS) and the European Association of Neurosurgical Societies (EANS) could improve the training structure for future neurosurgeons by organizing valuable fellowships and multicentre collaborations. Recently, a committee entitled "The Global and Humanitarian Neurosurgery Committee" was established to strengthen relations between the EANS and non-European Neurosurgical societies (Marchesini et al., 2022). Another great effort is by the NIHR Global Health Research Group on Neurotrauma, Cambridge, UK. Such collaborative initiatives are dedicated to organizing exchange programs and research fellowships to enhance ethical practice in neurosurgery globally. These global collaborations could improve the practice of medical ethics in neurosurgery.

6. Conclusion – how to ensure the best care?

The aforementioned issues about the drawbacks of the health care system and the barriers to precisely apply the medical ethics in the LMICs represents the poor health care policies of the government. To improve the situation as a whole, socio-economic development, including educating the citizens of these countries about their rights, functional regulatory bodies like medical and dental councils, teaching the neurosurgeons about the internationally recognized medical ethics, quality control regulations by the ministry of health and welfare, and more funding for the health care sectors are urgently needed. Moreover, a crucial collaborative role of the World Health Organization (WHO) is recommended to help the developing countries to provide their patients international but "customized" standard care. It needs to be customized, since it has to take into account the cultural background that influences the strength and how they apply the principles of medical ethics in the given society. To know the norms that are followed in the LMICs can help the neurosurgeons to implement the main principles that are generally listed adapting to the traditions and values of the affected patient groups. The collaborations of the international neurosurgical societies, for instance, WFNS and EANS, the support of the WHO is inevitable, and it is a moral duty as well to do so. The WHO Guidelines for Safe Surgery, 2009 provides a clear direction regarding the ethical principles of safe surgery (WHO Guidelines for Safe Surgery, 2009). These guidelines could be beneficial for the local medical associations in developing and disseminating realistic neurosurgical guidelines worldwide. Future research and clinical practice guidelines should also reflect the greater relevance of neurosurgical care in low resource settings.

The following mind map (Fig. 1) summarizes the main pillars and elements of the best care and emphasizes the most the most relevant interconnections between them.

The pillars influencing patient care are deeply interconnected, with improvements in one area often cascading into others. For instance, system-level enhancements, such as the development of more robust healthcare policies and increased funding, directly support professional-level improvements like enhancing the competency of ethics committees and providing better training for healthcare professionals. These improvements, in turn, can elevate the overall quality of care that patients receive.

One of the most critical methods for improving patient care begins at the system level. Strengthening healthcare policies and implementing internationally recognized medical ethics approaches are foundational steps. Increasing funding is also crucial, as it supports the infrastructure necessary for high-quality care. Additionally, enforcing quality control regulations and ensuring transparency through the duty of candour can significantly enhance accountability within the healthcare system.

At the professional level, fostering collaboration across disciplines and countries is essential for driving innovation and improving care standards. Securing sufficient research funding and ensuring that healthcare professionals are well-trained, particularly in emerging technologies, further contribute to delivering better patient outcomes. Competent ethics committees play a vital role in overseeing these processes, while ensuring an appropriate working environment is crucial for maintaining the well-being and effectiveness of healthcare providers.

The availability of technical and resource support is another key factor. Adequate financial backing for hospitals, proper maintenance of medical tools, and access to high-quality technologies are necessary for delivering effective and timely healthcare. Without these resources, even the best-trained professionals can struggle to provide the care patients need.

Last but not least, public-level education is a crucial component. Enhancing patients' knowledge through health education initiatives, such as audio-visual materials, helps demystify medical interventions and empowers patients to participate more actively in their care. Educating patients about their rights and the basic principles of medical ethics, particularly the concept of autonomy, ensures they are better informed and more engaged in decision-making processes.

By addressing these interconnected pillars—system-level policies, professional development, resource allocation, and public education—healthcare systems can significantly improve the quality of care provided to patients.

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Special note: The abbreviation LMICs is one category of the countries classification by their income. In this classification, World Bank differentiates low-income countries (LICs), low- and middle-income countries (LMICs), lower-middle-income countries (LoMICs), upper middle-income countries (UMICs), and high-income countries HICs.

In short, that means, poorer regions belong to the LICs, LMICs and LoMICs, e.g. most of Africa, a big part of Asia, part of Southern Europe, etc., and the richer ones belong to the UMIC and HIC, such as North America and a part of Latin America and the Caribbean.

Main GNI (Gross National Income) intervals: LICs with $1135 or less GNI per capita, LMICs between $1136 and $ 4465 GNI per capita, UMCs between $ 4466 and $ 13,845 GNI per capita, and HICs with $ 13.846 or more GNI per capita. See more: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (last visited: December 05, 2023)

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References

Alemayehu, C., Mitchell, G., Nikles, J., 2018. Barriers for conducting clinical trials in developing countries- a systematic review. Int. J. Equity Health 17, 37.
Ammar, A., 2014. Brief history of bioethics. In: Neurosurgical Ethics in Practice: Value-Based Medicine. Springer-Verlag Berlin Heidelberg, pp. 3–10.
Ammar, A., Bernstein, M., 2014. Cross-cultural ethics. In: Neurosurgical Ethics in Practice: Value-Based Medicine. Springer-Verlag Berlin Heidelberg, pp. 23–34.
Angelos, P., 2013. Ethics and surgical innovation: challenges to the professionalism of surgeons. Int. J. Surg. 11, S2.
Austin, L., 2021. Correia, diamond and the chester exception: vindicating patient autonomy? Med. Law Rev. 29 (3), 547–561.
Ayukekbong, J.A., Ntemgwa, M., Atabe, A.N., 2017. The threat of antimicrobial resistance in developing countries: causes and control strategies. Antimicrob. Resist. Infect. Control 6, 47.
Basu, S., Marcus, H.J., Sayal, P., Kitchen, N., Ley, R., Hutchinson, P.J., Thorne, L., 2020. Implementation of duty of candour within neurosurgery: a national survey and framework for improved application in clinical practice. Ann. R. Coll. Surg. Engl. 102, 144.
Bernat, J.L., Peterson, L.M., 2006. Patient-centered informed consent in surgical practice. Arch. Surg. 141, 86–92.
Broekman, M.L., Carrière, M.E., Bredenoord, A.L., 2016. Surgical innovation: the ethical agenda. Medicine (United States) 95.
Brownlee, S., Chalkidou, K., Doust, J., Elshaug, A.G., Glasziou, P., Heath, I., Nagpal, S., Saini, V., Srivastava, D., Chalmers, K., Korenstein, D., 2017. Evidence for overuse of medical services around the world. Lancet (London, England) 390, 156.
Clark, et al., 2022. Lancet Neurol. Casemix, Management, and Mortality of Patients Receiving Emergency Neurosurgery for Traumatic Brain Injury in the Global Neurotrauma Outcomes Study: a Prospective Observational Cohort Study, 21, pp. 438–449.
Esene, I., Baeesa, S., Ammar, A., 2016. Evidence-based neurosurgery. Basic concepts for the appraisal and application of scientific information to patient care (Part II). Neurosciences 21, 197–206.
Francis, C.M., 1996. Medical ethics in India: ancient and modern (I). Ind. J. Med. Ethics 4 (4), 115–118.
Gillon, R., 1994. Medical ethics: four principles plus attention to scope. BMJ (Clinical research ed.) 309, 184–188.
Gillon, R., 2015. Defending the four principles approach as a good basis for good medical practice and therefore for good medical ethics. J. Med. Ethics 41, 111–116.
Goel, A., Kothari, M., 2006. Ethics and neurosurgery. Neurol. India 54, 11.
Goel, A., Kumar, S., 2015. Bioethics, neurosurgery, and integral healing. J. Craniovertebral Junction Spine 6, 1–5.
Gray, D.P., 2010. Confidentiality: a core feature of general practice. Br. J. Gen. Pract. : J. Roy. Coll. Gen. Pract. 60, 780–782. ; discussion 781, 782.
Greenhalgh, T., 1987. Drug prescription and self-medication in India: an exploratory survey. Soc. Sci. Med. 25, 307–318.
Griswold, et al., 2020. Neurosurgery. Neurosurgical Randomized Trials in Low- and Middle-Income Countries, 87, pp. 476–483.
Hoffman, Paradise, 2008. Health insurance and access to health care in the United States. Ann. N. Y. Acad. Sci. 1136, 149–160.
Iqbal, et al., 2024. Neurosurgical malpractice litigation: a systematic review and meta-analysis. World Neurosurgery 188, 55–67. Aug.
Ismail, et al., 2023. Societal challenges facing neurosurgeons in low- and middle-income countries: Iraq as an example. Surg. Neurol. Int. 21 (14), 253.
Jaeger, F.N., Bechir, M., Harouna, M., Moto, D.D., Utzinger, J., 2018. Challenges and opportunities for healthcare workers in a rural district of Chad. BMC Health Serv. Res. 18.
Kaba, R., Sooriakumaran, P., 2007. The evolution of the doctor-patient relationship. Int. J. Surg. 5, 57–65.
Kolias, et al., 2022. JAMA Neurology. Evaluation of Outcomes Among Patients with Traumatic Intracranial Hypertension Treated with Decompressive Craniectomy vs Standard Medical Care at 24 Months: A Secondary Analysis of the RESCUEicp Randomized Clinical Trial, 79, pp. 664–671.
Leonardo, F., Lucas, A., 2020. Malpractice and socioeconomic aspects in neurosurgery: a developing-country reality. Neurosurg. Focus 49 (5), E13.
Maas, A.I.R., Menon, D.K., Adelson, P.D., Andelic, N., Bell, M.J., Belli, A., Bragge, P., Brazinova, A., Büki, A., Chesnut, R.M., Citerio, G., Coburn, M., Cooper, D.J., Crowder, A.T., Czeiter, E., Czosnyka, M., Diaz-Arrastia, R., Dreier, J.P., Duhaime, A.-C., Ercole, A., van Essen, T.A., Feigin, V.L., Gao, G., Giacino, J., Gonzalez-Lara, L.E., Gruen, R.L., Gupta, D., Hartings, J.A., Hill, S., Jiang, J.-Y., Ketharanathan, N., Kompanje, E.J.O., Lanyon, L., Laureys, S., Lecky, F., Levin, H., Lingsma, H.F., Maegele, M., Majdan, M., Manley, G., Marsteller, J., Mascia, L., McFadyen, C., Mondello, S., Newcombe, V., Palotie, A., Parizel, P.M., Peul, W., Piercy, J., Polinder, S., Puybasset, L., Rasmussen, T.E., Rossaint, R., Smielewski, P., Söderberg, J., Stanworth, S.J., Stein, M.B., von Steinbüchel, N., Stewart, W., Steyerberg, E.W., Stocchetti, N., Synnot, A., Te Ao, B., Tenovuo, O., Theadom, A., Tibboel, D., Videtta, W., Wang, K.K.W., Williams, W.H., Wilson, L., Yaffe, K., Agnoletti, V., Allanson, J., Amrein, K., Andaluz, N., Anke, A., Antoni, A., As, A.B. van, Audibert, G., Azaševac, A., Azouvi, P., Azzolini, M.L., Baciu, C., Badenes, R., Barlow, K.M., Bartels, R., Bauerfeind, U., Beauchamp, M., Beer, D., Beer, R., Belda, F. J., Bellander, B.-M., Bellier, R., Benali, H., Benard, T., Beqiri, V., Beretta, L., InTBIR Participants and Investigators, H., 2017. Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. Lancet Neurol. 16, 987–1048.
Marchesini, et al., 2022. Brain spine. Global neurosurgery amongst the EANS community: Where are we at? 28 (2), 100:911.
Masic, I., Hodzic, A., Mulic, S., 2014. Ethics in medical research and publication. Int. J. Prev. Med. 5, 1073–1082.
Mediratte, et al., 2021. Barriers to neurotrauma care in low- to middle-income countries: an international survey of neurotrauma providers. J. Neurosurg. 137 (3), 789–798.
Mukherjee, S., Pringle, C., Crocker, M., 2014. A nine-year review of medicolegal claims in neurosurgery. Ann. R. Coll. Surg. Engl. 96, 266.
Mushtaq, M.U., 2009. Public health in british India: a brief account of the history of medical services and disease prevention in colonial India. Indian J. Community Med. : official publication of Indian Association of Preventive & Social Medicine 34, 6–14.
Nandimath, O.V., 2009. Consent and medical treatment: the legal paradigm in India. Indian J. Urol : IJU : journal of the Urological Society of India 25, 343–347.
Page, K., 2012. The four principles: can they be measured and do they predict ethical decision making? BMC Med. Ethics 13, 10.
Peh, W., 2007. Scientific writing and publishing: its importance to radiologists. Biomed. Imaging Interv. J. 3, e55.
Powell, M., Hutton, M., 2016. The "three-legged stool: system for spinal informed consent. Bone Joint Lett. J 98-B (11), 1427–1430.
Punchak, et al., 2018. Neurosurgical care: availability and access in low-income and middle-income countries. World Neurosurgery e240–e254.
Qiu, R.-Z., 1988. Medicine—the art of humaneness: on ethics of traditional Chinese medicine. J. Med. Philos. 13, 277–300.
Qiu, R.-Z., 1991. Morality in Flux: Medical Ethics Dilemmas in the People's Republic of China. Kennedy Inst Ethics J, pp. 16–27. March.
Servadei, 2023. Neurotrauma care: a worldwide perspective. J. Neurotrauma 40, 597–601.
Tropeano, M.P., Spaggiari, R., Ileyassoff, H., Park, K.B., Kolias, A.G., Hutchinson, P.J., Servadei, F., 2019. A comparison of publication to TBI burden ratio of low- and middle-income countries versus high-income countries: how can we improve worldwide care of TBI? Neurosurg. Focus 47.
Umansky, F., Black, P.L., DiRocco, C., Ferrer, E., Goel, A., Malik, G.M., Mathiesen, T., Mendez, I., Palmer, J.D., Juanotena, J.R., Fraifeld, S., Rosenfeld, J.V., 2011. Statement of ethics in neurosurgery of the world federation of neurosurgical societies. World Neurosurgery 76, 239–247.
van den Hombergh, P., de Wit, N.J., van Balen, F.A.M., 2009. Experience as a doctor in the developing world: does it benefit the clinical and organisational performance in general practice? BMC Fam. Pract. 10, 80.
WHO Guidelines for Safe Surgery, 2009. Safe Surgery Saves Lives.
Worthington, R.P., Gogne, A., 2011. Cultural aspects of primary healthcare in India: a case- based analysis. Asia Pac. Fam. Med. 10, 8.
Xu, T.-M., 1990. China: moral puzzles. Hastings Cent. Rep. 24–25. March/April.