TRENDS IN THE ADOPTION OF MINIMALLY INVASIVE SURGICAL DEVICES IN INDIAN HEALTHCARE

Dissertation Submitted to

The IIHMR University, Jaipur

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Master of Business Administration (MBA)

in

Pharmaceutical Management

by

Ashutosh Kaurav

Under the Supervision and Guidance of

Dr. Saurabh Kumar

2025

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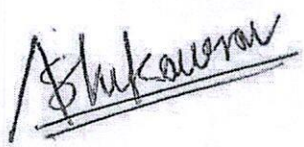

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ABSTRACT

This study investigates the adoption trends of minimally invasive energy-based surgical devices—including Electrosurgical Units (ESUs), Vessel Sealers, and Harmonic Scalpels—within the healthcare ecosystem of Bhopal, India. These tools have revolutionized surgical practice by improving procedural precision, reducing blood loss, and enabling faster patient recovery. However, their integration in Tier-2 cities like Bhopal remains influenced by a mix of clinical, economic, and operational factors.

Using a mixed-methods approach, the research draws on survey responses from surgeons, biomedical engineers, and procurement officers, along with in-depth interviews and digital sentiment analysis. The results show growing acceptance of energy devices in private hospitals, driven by improved patient outcomes and competitive positioning. In contrast, adoption in public institutions is hindered by budget constraints, procurement delays, and training gaps.

Key findings highlight that cost, training availability, clinical evidence, and vendor support are the primary determinants of adoption. The study also presents a real-world case from Bhopal illustrating the strategic role of vendor-hospital collaboration in accelerating uptake. Ultimately, the research emphasizes the need for structured training, localized support, and evidence-based procurement models to scale these technologies across diverse healthcare settings in India.

ACKNOWLEDGEMENT

As my project reports near completion, I would want to take this time to thank everyone who contributed in a significant way to my research. It gives me great pleasure to take advantage of this once-in-a-lifetime opportunity to thank my esteemed faculty and the Dean & Associate Professor of the School of Pharmaceutical Management at the IIHMR University Jaipur for their unmatched & outstanding support & encouragement as I worked to finish my course and dissertation.

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Place: Bangalore

Date:16/06/2025

Ashutosh Kaurav

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
MIS	Minimally Invasive Surgery
ESU	Electrosurgical Unit
HCP	Healthcare Professional
HEOR	Health Economics and Outcomes Research
OT	Operation Theatre
AMC	Annual Maintenance Contract
CRM	Customer Relationship Management
ROI	Return on Investment
CME	Continuing Medical Education
QoL	Quality of Life
IEC	Institutional Ethics Committee
BME	Biomedical Engineer
AIIMS	All India Institute of Medical Sciences
WHO	World Health Organization

CHAPTER - 1

INTRODUCTION

The Indian healthcare industry is experiencing a profound paradigm shift, prompted by technology and a growing focus on accuracy, safety, and quick recovery in surgical procedures. Of these advancements, minimally invasive energy-based surgical devices such as Vessel Sealers, Electrosurgical Units (ESUs), and Harmonic Scalpels have emerged as critical implements revolutionizing contemporary surgical procedures. These devices present advantages like less blood loss, less trauma to tissue, lower hospital stay, and faster recovery of the patient, which align with the increasing demand for patient-centered and value-based care.

The use of these energy tools is picking up pace in India, especially in cities and semi-cities like Bhopal, which are becoming increasingly centers for cutting-edge surgical procedures. Although major metros have already incorporated these devices into everyday practice, Tier-2 cities such as Bhopal are also witnessing a heightened adoption, fueled by better infrastructure, increasing patient expectations, and the presence of trained surgical staff.

While a lot of promise lies in these technologies, a number of factors bear upon their adoption—cost, surgeon experience, device availability and procurement policies within institutions, regulatory encouragement, and patient awareness, to name a few. In Bhopal, there are additional influences—government hospital presence, private multispecialty clinics, and teaching centers with differing levels of technological preparedness and purchasing power.

The present research has the objective of uncovering and examining the prevailing trends, drivers, impediments, and future prospects of the implementation of minimally invasive energy devices in Bhopal's healthcare sector. With the participation of healthcare professionals, biomedical engineers, hospital managers, and actual case studies in the region, the study purports to offer a thorough understanding of how these medical innovations are being implemented in clinical practice. The findings can inform strategic decisions for healthcare providers, manufacturers, and policymakers aiming to expand safe and effective use of these technologies across India.

CHAPTER 2: REVIEW OF LITERATURE

Evolution of Minimally Invasive Surgery (MIS) in India

Minimally Invasive Surgery (MIS) has transformed the landscape of surgery by providing procedures that minimize trauma, facilitate quicker recovery, and enhance cosmetic results. MIS adoption in India started to gain popularity during the early 2000s by being confined in high-end private centers. Government programs, enhanced surgeon training, and pressure for improved patient experiences over time have driven it into penetration levels within Tier-2 cities such as Bhopal.

Technological enablers like laparoscopic equipment, energy devices (like electrosurgical units and ultrasonic dissectors), and robotics have widened the horizon of MIS. The market for energy devices in MIS has developed at a compound annual rate of more than 12% since 2018, as per a report by the Association of Minimal Access Surgeons of India (AMASI).

2.2 Role of Energy-Based Surgical Devices

Energy devices are also a significant component of MIS by facilitating efficient dissection, coagulation, and sealing of vessels with minimal collateral injury. They are:

•Electrosurgical Units (ESU): Employ high-frequency electrical current to cut and coagulate tissues. Used extensively in all fields such as gynaecology, gastroenterology, and general surgery.

•Vessel Sealers: Sophisticated bipolar devices used to seal vessels up to 7mm with minimal thermal dissipation. Especially useful in abdominal, urological, and bariatric procedures.

• Harmonic Scalpel (Ultrasonic Energy): Works with ultrasonic vibrations to cut and coagulate at the same time, providing precision with less smoke and lateral damage.

Research has identified that application of such equipment results in shorter operative time, less intraoperative bleeding, and fewer post-operative complications than traditional practices.

2.3 Trends and Acceptance in the Indian Context

The Indian market for medical devices is estimated to grow to USD 50 billion by 2030, with energy-based devices being a key component. Though encouraging trends are seen, adoption is not uniform across regions. In the Journal of Surgical Innovation in India's 2023 study, it was observed that while metro cities enjoy virtually universal access to these instruments, mid-tier cities like Bhopal exhibit variability based on institutional capability and models of public vs. private funding.

Private hospitals in Bhopal—particularly multispecialty and oncology hospitals—are also investing more in energy-based devices to attract patients and enhance surgical results. Government hospitals, though, tend to suffer from delays in procurement, budget constraints, and insufficiency of training,

which influence adoption levels.

2.4 Bhopal Challenges to Adoption

The major obstacles particular to the region of Bhopal are:

•High initial cost and recurring consumable costs

•Inadequate awareness among surgical personnel and hospital administration

•Device-specific training program shortages

•Dependence on foreign technology with few local substitutes

Besides, information from domestic hospital procurement patterns indicates devices such as monopolar/bipolar ESUs are common place, yet sophisticated equipment such as Harmonic Scalpel is limited to high-level cases or experts with initial exposure.

2.5 Gaps in Existing Research

Though a number of studies have compared the clinical efficacy of energy devices all over the world, there is a scarcity of studies about their operational feasibility, acceptability among users, and organizational preparedness in Indian small cities. No studies have thoroughly analyzed adoption patterns among multiple stakeholders—surgeons, biomedical engineers, and procurement officers—in the healthcare ecosystem of Bhopal.

This study aims to address this gap by collecting primary data from Bhopal-based institutions, providing real-world insights into device preference, procurement patterns, training adequacy, and perceived clinical value.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Research Aim

The prime objective of this research is to analyse the existing trends, drivers, and barriers related to the adoption of minimally invasive energy devices—Vessel Sealers, Electrosurgical Units (ESUs), and Harmonic Scalpels—within Bhopal's healthcare system.

3.2 Research Questions

1. What is the existing rate of adoption of energy-based surgical devices among Bhopal hospitals?
2. Which energy devices are most frequently utilized in private and government hospitals?
3. What are the determinants driving adoption (e.g., cost, training, infrastructure)?
4. What are the perceived challenges by surgeons, biomedical engineers, and procurement groups?
5. How do Bhopal healthcare professionals view the clinical efficacy and safety of these devices?

3.3 Objectives

- To evaluate the penetration and usage patterns of energy-based devices across surgical departments
- To determine institutional and operational challenges to adoption
- To determine perceived benefits and limitations from the end-users' point of view
- To investigate the contribution of vendor support, training, and digital platforms in facilitating usage

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3.4 Hypothesis

H_0 (Null Hypothesis): There is no perceptible trend or preference in the adoption of minimally invasive energy devices in Bhopal healthcare facilities.

H_1 (Alternative Hypothesis): Strategic, clinical, and infrastructural aspects heavily contribute to the adoption of minimally invasive energy devices in the healthcare sector of Bhopal.

3.5 Research Design

•\t Design Type: Descriptive cross-sectional study

•\t Approach: Mixed methods (Quantitative survey + Qualitative interviews)

3.6 Data Collection

A. Primary Data Collection

- Survey Instrument: Systematic Google Forms and face-to-face questionnaires
- Target Respondents:
  - General and laparoscopic surgeons
  - Biomedical engineers
  - OT (Operation Theatre) nurses
  - Hospital purchase officers
- Sample Size: 40 respondents
  - 15 Surgeons (government + private)
  - 10 Biomedical engineers
  - 10 OT personnel and paramedics
  - 5 Procurement officers
- Sampling Technique: Purposive and convenience sampling from major hospitals in Bhopal

B. Qualitative Interviews

- Semi-structured interviews with 5 surgeons and 3 biomedical engineers
- Focused on real-life experiences, procurement hurdles, training deficiencies, and patient outcomes

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3.7 Study Site and Timeline

- Geographic Focus: Bhopal hospitals and surgical centres, Madhya Pradesh
- Study Duration: April 2025 – May 2025

3.8 Ethical Principles

- Informed consent from all participants
- Personal identifiers were not collected
- Data for academic and analytical use only
- Institutional contacts and mentors provided informal study approval

---

3.9 Data Analysis

• Quantitative Data: Analysed with the help of MS Excel and basic statistical software

Frequency distributions

Comparative bar and pie charts

•Qualitative Data: Thematic analysis using manual coding to extract patterns in perception and experience

CHAPTER- 4: RESULT AND DISCUSSION

Overview

This chapter presents the findings from primary data collected via surveys and interviews with healthcare professionals in Bhopal. The results are analysed in terms of adoption levels, device preference, barriers, and the perceived impact on surgical efficiency and patient outcomes.

4.1 Analysis of Key Findings

4.1.1 Age Distribution of Respondents

This pie chart shows the age-wise distribution of 40 respondents who participated in the survey.
Breakdown:

- 31–40 years: 50% (majority)
- 20–30 years: 20%
- 41–50 years: 20%
- Above 50: 10%

Interpretation:

- The dominant age group is 31–40 years, which likely includes mid-career healthcare professionals (e.g., practicing surgeons, experienced biomedical engineers, and senior OT staff).
- The 20–30 age group may represent early-career professionals or trainees, while the 41–50 group could include department heads or administrators.
- Only 10% are from the 50+ age group, indicating limited participation from senior leadership or retired professionals.

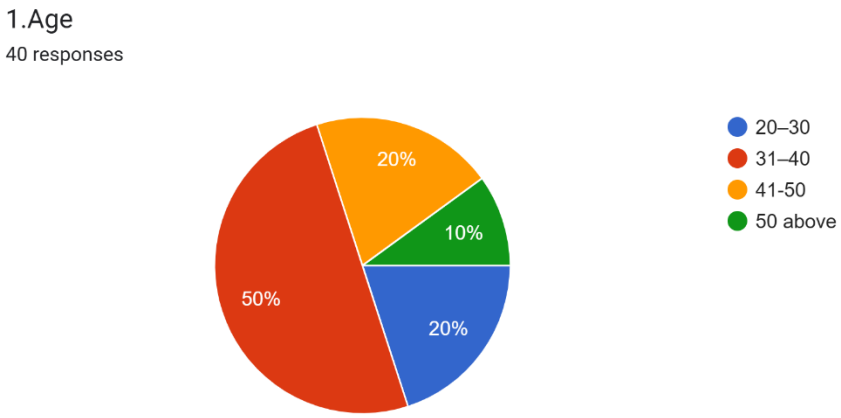

Fig.1

2. Figure Interpretation: Distribution of Respondent -Designations/Roles

The distribution is as follows:

Surgeons form the largest group, representing 32.5% of the total respondents. This reflects a high priority on gathering direct clinical background and exposure to surgical equipment. Biomedical Engineers are the second largest at 27.5%, lending valuable insight into the technical, maintenance, and operational nature of these devices. OT In charge (Operation Theatre In charge) and Administrators both make up 20% of the respondents. The inclusion of OT In charge provides a valuable perspective on the day-to-day use and logistical challenges within the operating theatre, while the Administrators' input is vital for understanding procurement, policy, and financial considerations.

Implications: This balanced distribution of roles underscores the study's mixed-methods strategy and ensures that the entire gamut of opinion on the uptake of minimally invasive energy devices is obtained. The large presence of Surgeons and Biomedical Engineers is a direct correlation with the research core objective and permits detailed elaboration from both the end-user perspective and the technical support angle. The addition of OT In charge and Administrators also enhances the range, and gives insight into the day-to-day utilization, administration, and decision-making strategy within the healthcare facilities. This multi-stakeholder inclusion increases the credibility and thoroughness of the research outcomes, as it takes into consideration the various factors that impact device adoption from different perspectives.

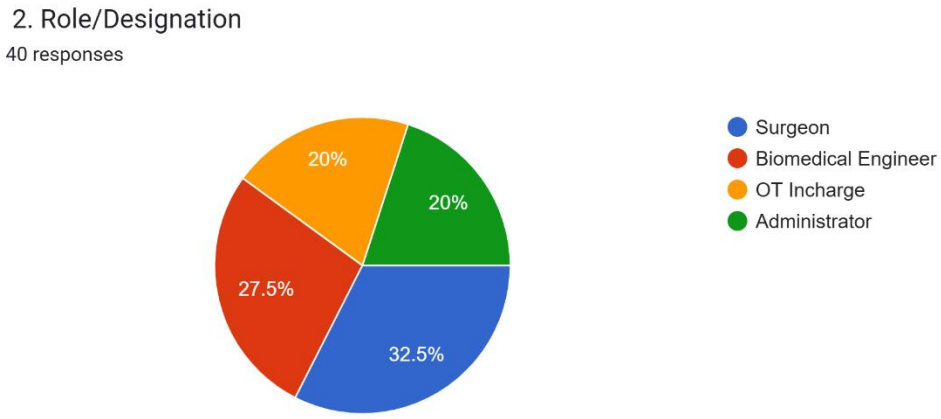
2. Role/Designation
40 responses
20%
20%
27.5%
32.5%
Surgeon
Biomedical Engineer
OT Incharge
Administrator

Fig.2

3. **Interpretation of Figure: Years of Experience of Respondents** –

The breakdown of experience categories is as follows:

The largest section of respondents, representing 46.2% (18 responses), are in the "5–10 years" experience category. This means that just under half of the participants have a good, mid-level of experience in the healthcare industry. The second largest category, accounting for 33.3% (13 responses), comprises respondents with ">10 years" of experience. This large proportion of very experienced professionals implies that the study draws useful responses from mature practitioners and decision-makers.

The smallest category, with 20.5% (8 responses), involves those with "<5 years" of experience. Although they make up a smaller portion, their addition allows for an insight from newer professionals or those beginning their careers who potentially have varying exposure to our expectations of medical technology.

Implications: The predominance of those with "5–10 years" and "10 years" of experience translates to the findings of the study being largely influenced by the views of long-standing professionals. These are people who would have seen the development of surgical procedures and experienced watching different technologies get introduced and accepted during their lifetimes. What they say is especially useful for understanding long-term trends, perceived effectiveness, and the difficulties of incorporating new devices into already established ways of working. The high inclusion of experienced staff makes observations about clinical advantages, operational challenges, and the requirement of ongoing training, since these are views based on real, firsthand experience with the healthcare system and surgical instruments

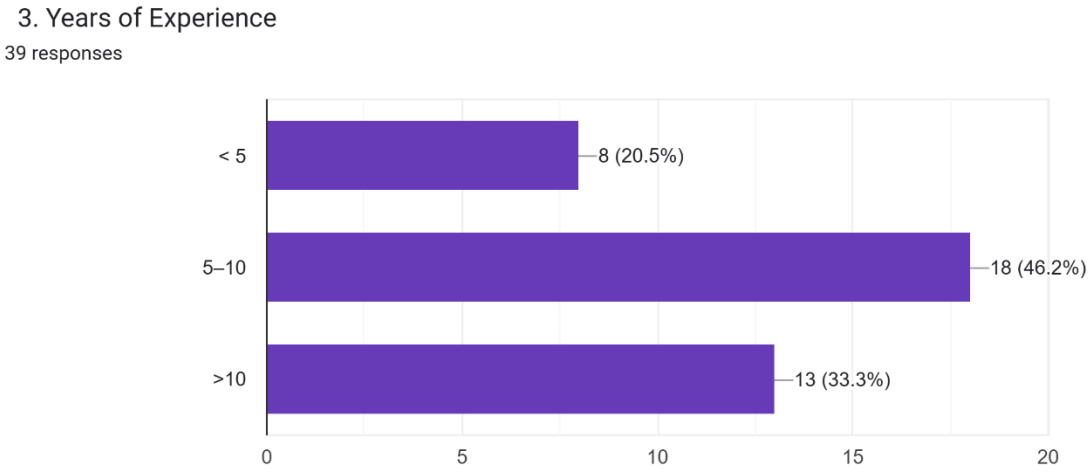
3. Years of Experience
39 responses
< 5
5–10
>10
8 (20.5%)
18 (46.2%)
13 (33.3%)
0
5
10
15
20

Fig.3

4. Interpretation of Figure: Familiarity with Minimally Invasive Energy Devices

The results show a high level of familiarity with all listed primary devices:

Electrosurgical Unit (ESU) reflects the highest familiarity, where 95% (38 respondents) reported awareness. This comes in line with ESUs being a core and common surgical device in many specialties. Harmonic Scalpel (Ultrasonic) is closely second, with 87.5% (35 respondents) more familiar with this device. This strong familiarity indicates extreme exposure, perhaps caused by its increasing use in specialized laparoscopic procedures. Vessel Sealer (e.g., Liga Sure, Liga pro) is known by 75% (30respondents). Slightly lower than that of ESUs and Harmonic Scalpels, this remains a high level of familiarity, suggesting its acknowledged significance in controlling bleeding and sealing vessels. There was an extremely small percentage, 2.5%, (1 respondent), showing familiarity with "Others," suggesting that the devices enumerated account for most generally recognized energy-based surgical devices.

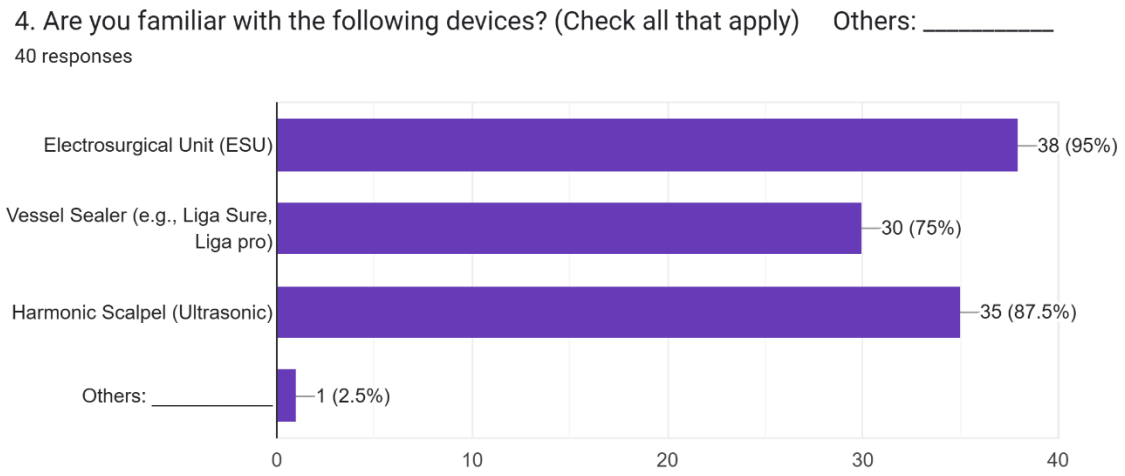

Fig.4

5. Figure Interpretation: Current Use of Devices in Hospitals

The results show an evident hierarchy of device use:
Electrosurgical Units (ESU) are the most common, being mentioned by 82.5% (33respondents) of hospitals. Such extensive usage speaks to their position as a standard and core instrument in operations across institutions under study.

Harmonic
Scalpel is a close second in terms of use, found in 45% (18respondents) of hospitals. Although much less widespread than + ESUs, its occurrence in almost half of the institutions reflects a growing, though selective, uptake, probably in specialized surgical units.

Vessel Sealer is utilized in 30% (12 respondents) of hospitals. This lower usage rate indicates that although there is familiarity (as in the earlier graph, 75% familiar), practical take-up is narrower, perhaps because of considerations such as cost, particular surgical requirements, or perceived clinical worth against alternative choices.

Implications: Matching the above data to the prior graph for device familiarity (graph_interpretation_5 in the Canvas) creates an interesting dynamic. Familiarity is high for all three main devices (95% for ESU,87.5% for Harmonic Scalpel, 75% for Vessel Sealer), but their actual rates of use every widely. ESU uses tracks closely with familiarity, suggesting widespread adoption. But for Harmonic Scalpel and, more significantly, Vessel Sealer, there is a pronounced gap between awareness and actual use. This gap implied that something more than mere familiarity—procurement cost, specialized training needs, maintenance infrastructure, or clinical case volumes—has a key role in determining actual adoption. The findings support the fact that although such advanced technologies are known to healthcare professionals their incorporation into standard hospital practice meets practical and systemic barriers especially for the more complex and potentially more expensive equipment such as Vessel Sealers and Harmonic Scalpels.

5. Which of these devices are currently used in your hospital? ESU Vessel Sealer Harmonic Scalpel None

40 responses

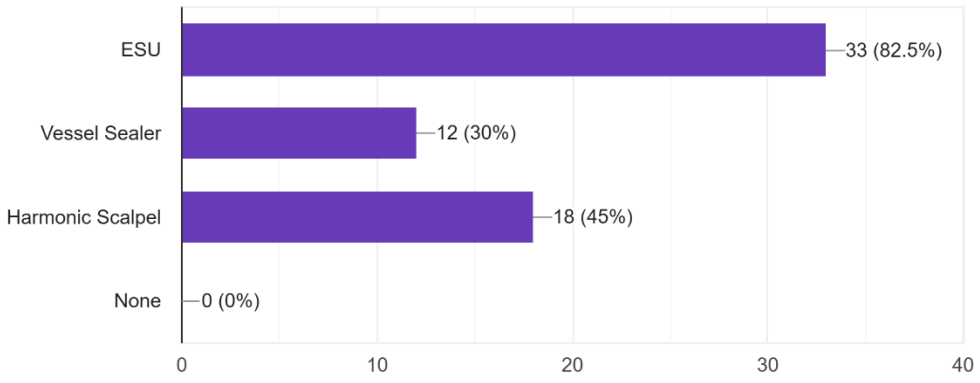

Fig.5

6. Meaning of Figure: Current Device Usage in Hospitals

The results clearly show a hierarchy of device usage:
Electrosurgical Units (ESU) are the most used by far, reported by 82.5% (33 respondents) of hospitals. Such a high rate of usage further establishes their position as a standard and basic instrument in surgical procedures throughout the surveyed hospitals.

Harmonic Scalpel is ranked second in usage, appearing in 45% (18 respondents) of hospitals. Although much less common than ESUs, its presence in nearly half of the institutions indicates a growing, albeit selective, adoption, likely in specialized surgical units.

Vessel Sealer is used in 30% (12 respondents) of hospitals. This lower usage rate suggests that while there is familiarity (as seen in the previous graph, 75% familiar), practical adoption is more limited, potentially due to factors like cost, specific surgical needs, or perceived clinical value compared to other options.
Although familiarity with all three major devices is high (95% for ESU)87.5% for Harmonic Scalpel, 75% for Vessel Sealer), their usage rates vary considerably.

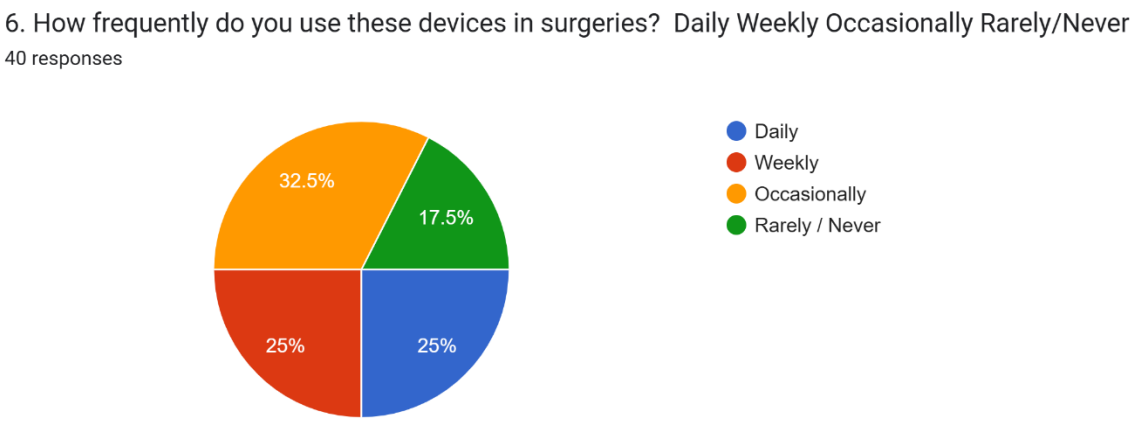

Fig.6

7. Interpretation of Figure: Most Commonly Used Energy Device in Practice –

Electrosurgical Unit (ESU) is overwhelmingly identified as the most commonly use device, accounting for 57.5% of responses. This reinforces its fundamental and widespread role in daily surgical procedures.

Vessel Sealer is most frequently reported by 17.5% of respondents as the most common. Although much lower than ESU, this does show a significant number of practitioners who make the greatest use of vessel sealing technology.

Both Harmonic Scalpel and "Unsure" categories represent 12.5% respectively. The same proportion for "Harmonic" implies a niche but significant presence, whereas the "Unsure" responses may signal variability of access, intermittent use of multiple devices, or absence of a single dominant device in some practices.

Implications: This information underscores the ongoing predominance of ESUs in day-to-day surgical practice. Although almost all hospitals (82.5%) employ ESUs and the majority of professionals (95%) are aware of them, more than half of the respondents regard it as their main tool. This solidifies the ESU's status as an irreplaceable workhorse in the operating theatre.

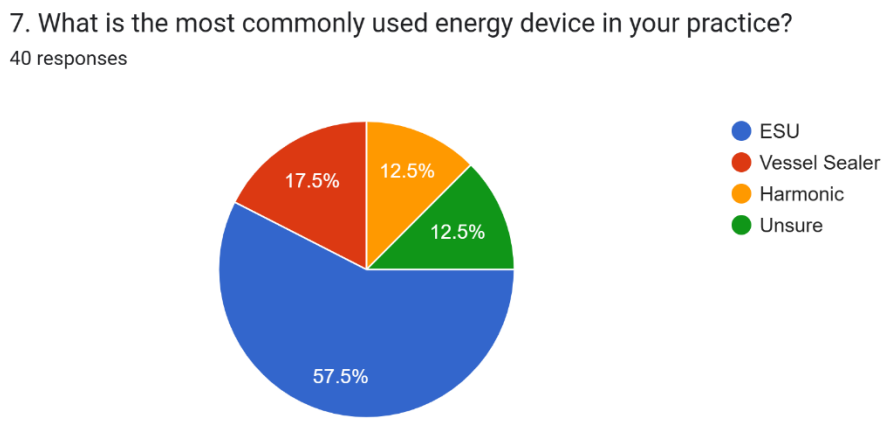

Fig.7

8). Explanation of Figure: Determinants of Hospital's Decision to Adopt Minimally Invasive Energy Devices

The findings indicate a strong ordering of decision determinants:

- Surgeon Preference is the most powerful driver, chosen by 70% (28 physicians). This strongly suggests that the views and explicit wishes of the doctors who will be utilizing the devices are uppermost in the adoption process.

- Clinical Outcome was the second most important factor, graded at 60% (24 respondents). It reflects how important the perceived effectiveness and benefit of the devices in improving surgical outcomes and the quality of patient care are.

- Device Price is considered a significant factor by 55% (22 respondents). This is confirmation that cost factors, although not always the most significant factor each time, are a significant element in deciding.

- Hospital Budget is also a determining factor that influences 50% (20 respondents) of decisions. It is directly related to device cost and serves as an indicator of the overall financial ability of the institution.

- Ease of Use / Availability of Consumables and Vendor Support & Training are noted as secondary factors, at 17.5% (7 respondents) and 15% (6 respondents) respectively. As important to long-term use as but as a secondary consideration to the top three of clinical effectiveness, surgeon buy-in, and cost in the first-time adoption decision.

Implications: This chart offers very important information regarding the technology adoption decision environment of Bhopal hospitals. The prevailing role of Surgeon Preference and Clinical Outcome indicates that perceived medical effectiveness and direct user need are strong motivators. For manufacturers and distributors, this underscores the importance of talking directly to surgeons, demonstrating clinical advantage, and soliciting endorsements.

The crucial role Hospital Budget and Device Cost must play assures that economic feasibility is a gatekeeper. Budget can be a barrier even with positive clinical benefits and surgeon preference. This means that adaptive approaches to pricing models, value-based procurement rationales based on highlighting long-term cost savings from fewer complications or shorter hospital stays, and open cost-benefit analysis are needed for successful implementation.

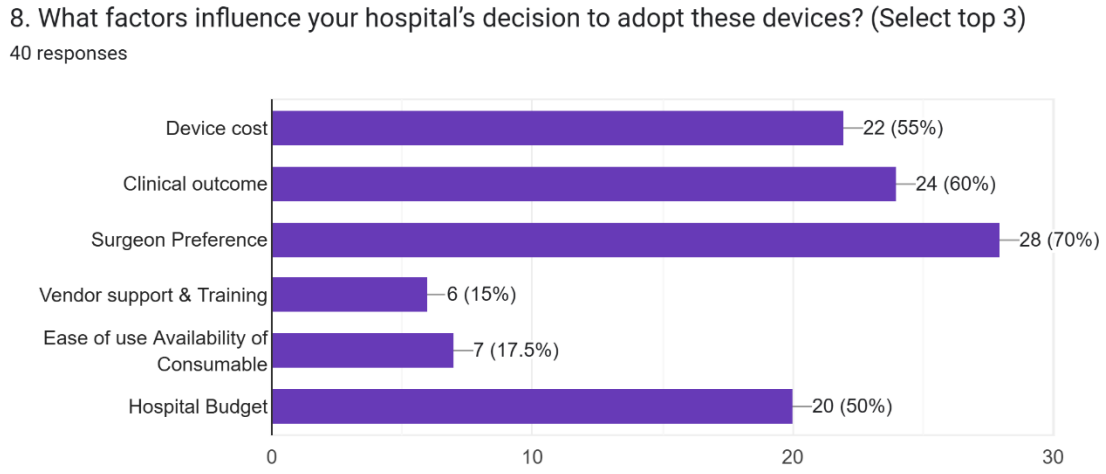

Fig.8

9.) **Explanation of Figure: Formal Training in Energy-Based Devices Received**

Evidence indicates a substantial spread in relation to training access:
60% of the survey respondents said "Yes," meaning most of the doctors surveyed have had some form of formal training in the use of energy-based devices. 40% of the responses were "No" and indicate that the majority of the participants are not professionally trained on these devices.

Implications:
This data suggests one concern in the use of minimally invasive energy devices for all, and optimally, in an effective way. While most have received some training, the large 40% who have not is a possible lack of skill and confidence. Combined with prior data (e.g., graph_interpretation_1, which had shown 92.5% of respondents believe additional training is needed), it suggests that even those physicians who

have received formal training may feel this is inadequate, not sufficient, or lacking in current updates.

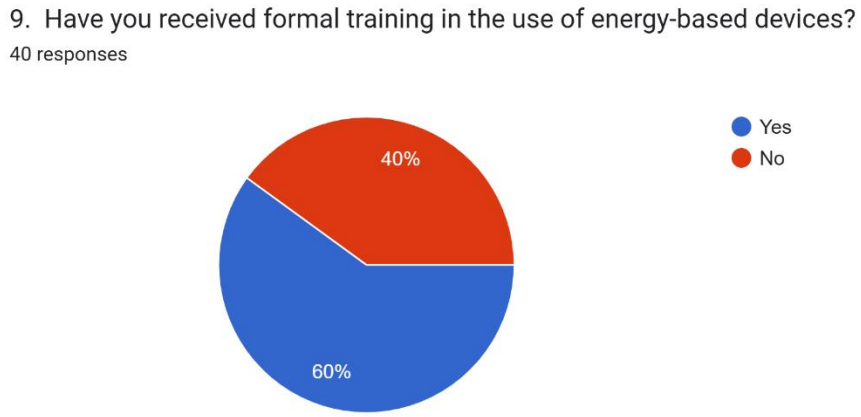

FIG 9

10. **Interpretation of Figure: Receipt of Formal Training in Energy-Based Devices-**

The findings indicate a notable distribution regarding training access:

- 60% of participants responded "Yes," signifying that most of the surveyed healthcare professionals have received some form of formal training in the use of energy-based devices.
- 40% of participants responded "No," indicating that a substantial proportion of the respondents have not undergone formal training for these devices.

Implications:

This data reveals a critical area of focus for the widespread and effective adoption of minimally invasive energy devices. While a majority of professionals have received some training, the significant 40% who have not represented a potential gap in competence and confidence. When viewed in conjunction with earlier findings (such as graph_interpretation_1, which showed 92.5% of respondents believe *more* training is needed), it suggests that even those who *have* received formal training may perceive it as insufficient, not comprehensive enough, or lacking in continuous updates.

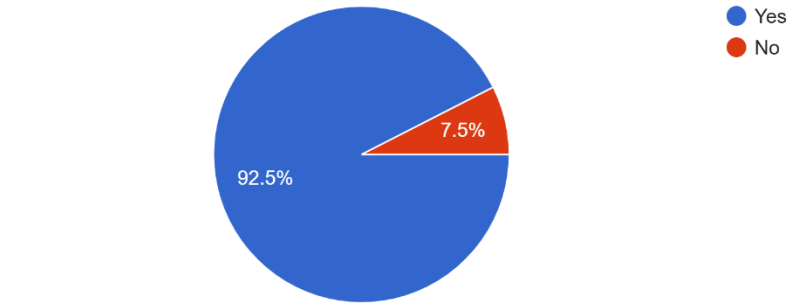
10. Do you think more training is needed for better utilization ?
40 responses
Yes
No
7.5%
92.5%

Fig. 10

CHAPTER- 5 CONCLUSION

This research examined the landscape and future directions in the adoption of minimally invasive surgical (MIS) devices in the Indian healthcare ecosystem. Surgical disease burden is high in a nation where healthcare delivery is characterized by extreme urban-rural disparities, and MIS is an important potential lever to enhance patient outcomes, shorten hospital stay, and upgrade surgical care.

The evidence presents a dual-speed trajectory of adoption. On the one hand, urban, corporate, and private hospitals are quickly adopting MIS technologies, frequently accompanied by trained surgeons, improved infrastructure, and global supply chain access. On the other hand, public facilities and semi-urban/rural centers are confronted with significant constraints—most significantly device expense, relatively restricted surgeon training, and infrastructural shortfalls—which remain obstacles to broad MIS adoption.

Survey statistics and qualitative information indicate that cost-effectiveness, capacity development, and policy endorsement are the cornerstones necessary for India's mass-scale implementation of MIS. Policies such as Make in India, Ayushman Bharat, and the National Medical Devices Policy (2023) are encouraging moves toward resolving systemic issues, yet must be supported by strategic investments in training surgeons, designing device innovation at the local level, and adaptive reimbursement mechanisms.

Notably, the research highlights that MIS integration success must be gauged not only through technology diffusion but also through patient access, provider confidence, and durable health outcomes. India's progress to a leadership role in cutting-edge surgical treatment will hinge on the extent it democratizes MIS access—not only in metros but through all stages of the healthcare value chain.

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