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A Survey on Implantable Medical Device

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ABSTRACT:

Through the management of several diseases and the preservation of countless lives, implantable medical devices (IMDs) such as pacemakers, implantable cardiac defibrillators (ICDs), drug delivery systems, and neurostimulators greatly improve healthcare. Through their ability to facilitate patient identification, monitoring, and treatment regardless of time or location, they play a crucial role in achieving the goal of ubiquitous healthcare. IMDs have many useful features, but they can also be vulnerable to malware and malicious assaults, which raises severe privacy and patient safety risks. To solve these issues, secure wireless communication is necessary, which calls for a well-coordinated application of both technology and law. This paper offers a thorough analysis of the literature on safe wireless communication for IMDs, covering possible security risks, difficulties with system design, and suggested security enhancing method.

Keywords: Implantable devices, heart, dental, kidney, bones

NTRODUCTION:

Implantable Medical Devices (IMDs) are surgically implanted to monitor and treat medical conditions, improving patient outcomes and quality of life. Made from biocompatible materials, they offer personalized, innovative solutions for healthcare. [1,2,3,4]

Implantable medical devices, like pacemakers and insulin pumps, provide life-saving support for chronic conditions through advanced, biocompatible technologies. Their development involves collaboration among engineers, medical experts, and researchers to ensure safety and effectiveness. [4,5,6,7]

Designing implantable medical devices requires focus on reliability, longevity, and physiological compatibility, along with advancements in wireless connectivity for remote monitoring. However, challenges like surgical risks, device maintenance, and ethical concerns regarding patient autonomy and privacy must be carefully managed. [8,9,10,11,12]

Ongoing research in implantable medical devices drives advancements in personalized medicine, aiming to meet unmet medical needs and improve patient outcomes, shaping the future of healthcare delivery [13].

METHODOLOGY:

Materials and methods:

The materials used for the survey were different devices, collection of information of the devices visa the survey from the patients, Doctors, devise manufacture company. Following is the information about the IMDs as per organ:

HEART:

Pacemaker:

A pacemaker is a tiny, battery-operated gadget that stops the heart from beating too slowly. A pacemaker requires surgery to be installed. The apparatus is positioned close to the collarbone beneath the skin. [17,18,36]

An alternative name for a pacemaker is a cardiac pacing device. [35]

Different pacemaker kinds exist:[14]

- Single-chamber pacemaker
- Dual-chamber pacemaker
- Biventricular pacemaker

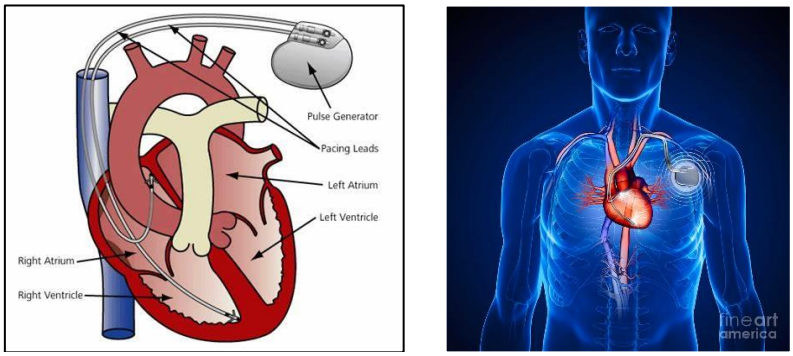

Fig: 1 Pacemaker

2. Implantable Cardioverter Defibrillator (ICD):

An implantable cardioverter-defibrillator (ICD) is a small device placed in the chest that monitors and corrects irregular heartbeats, delivering electric shocks to restore a normal rhythm. It's often used for individuals with severe arrhythmias, such as ventricular tachycardia or ventricular Fibrillation. [46,15,14,13,34]

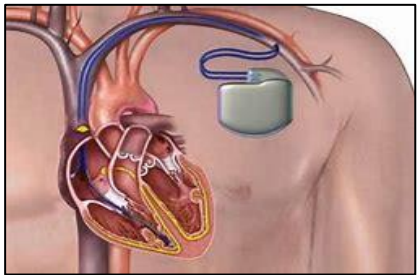

Fig: 2 Implantable Cardioverter Defibrillator (ICD

3. Cardiac Resynchronization Therapy (CRT) Device:

Cardiac Resynchronization Therapy (CRT) devices improve heart failure by synchronizing the left and right ventricles using electrodes connected to a device implanted under the skin. There are two types: CRT-P, which includes a pacemaker with leads to the atria and ventricles, and CRT-D, which combines CRT with an implantable cardioverter-defibrillator (ICD). [9,11,47]

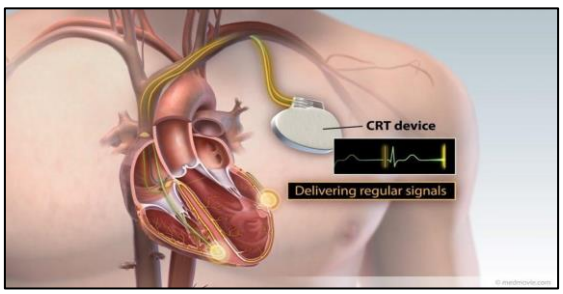

Fig: 3 Cardiac Resynchronization Therapy (CRT) Device

4. Implantable Loop Recorders (ILRs):

Implantable loop recorders (ILRs) are small devices used to continuously monitor heart rhythm in individuals with palpitations, unexplained fainting (syncope), or other potential cardiac arrhythmias.

Aftercare:

After ILR installation, patients may need periodic follow-up consultations with their cardiologist or electrophysiologist to review recorded data, adjust device settings, and assess heart health. Healthcare providers can also remotely retrieve and evaluate the recorded data using specific hardware or software.

Fig: 4 Implantable Loop Recorders (ILRs)

5. Left Ventricular Assist Devices (LVADs):

Patients with progressive heart failure can have left ventricular assist devices (LVADs) implanted to help the heart pump blood to other organs in the body [45].

Aftercare:

After LVAD implantation, patients require lifelong follow-up care from a specialized heart failure team, including cardiologists, cardiac surgeons, and LVAD coordinators. Regular clinic visits are scheduled to monitor the device's performance, assess the patient's overall health, and address any issues. Patients also receive instruction on emergency protocols, battery management, driveline maintenance, and other aspects of device management. [35]

Fig: 5 Left Ventricular Assist Devices (LVADs)

DENTAL:

1. Root canal therapy:

A tooth that is diseased, decaying, or damaged can be treated and saved by root canal therapy, also referred to as endodontic treatment. [31]

Aftercare: After a root canal, it's important to follow the dentist's instructions, including taking medication, practicing good dental hygiene, and going to follow-up appointments. Most patients experience reduced pain afterward, though some might still feel some soreness or sensitivity for a few days [59].

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Fig: 6 Root canal therapy

2. Dental Implants:

Aftercare

- Pain Control
- Maintaining Oral Hygiene
- Avoid alcohol and tobacco
- attendance at the scheduled follow-up visits
- protecting the implant
- Frequent Dental Appointments. [61]

Fig:7 Dental implants

Dental crown

A dental crown is a cap that resembles a tooth that is used to replace a tooth that has deteriorated or broken in order to restore its strength, size, form, and appearance. When a tooth is badly decaying, weak, cracked, or fractured, it is frequently utilized.

Aftercare:

A dental crown can endure for many years with good maintenance, but regular wear and tear or damage may eventually require replacement. Frequent dental examinations, brushing, and flossing can help your crown last longer.

Fig: 8 Dental crown

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Dental veneers

Dental veneers are thin, custom-designed shells composed of composite resin or porcelain that are placed over teeth's front surfaces to enhance their appearance. They are frequently employed to treat a range of dental conditions, such as:

- Discoloration
- Chips and cracks
- Uneven spacing or gaps
- Misshapen teeth

Aftercare:

When given the right care, such as consistent brushing, flossing, and dental examinations, dental veneers are strong and can endure for many years. However, normal wear and tear may eventually require their replacement.

Fig: 9 Dental veneers

Dental bonding

The process of applying a tooth- colored composite resin substance to a tooth, shaping it into the desired form, hardening it, and polishing it is known as dental bonding. It's frequently used to fix small misalignments, discolorations, chips, cracks, and gaps in teeth in order to make them seem better. This is an easy-to-read list:

1. Fix cracks and chips

2. Seal the spaces between teeth

3. Reduce discolouration of teeth

4. Resculpt unequal or crooked teeth

Fig: 10 Dental bonding

BONES: Bone is a unique tissue that is capable of repairing itself after damage. However, there are certain instances of fractures and defects that require clinical intervention for proper alignment and healing. As with any implant, careful consideration of the material used to create the implants to treat these problems is needed. [10]

Hip Joint Implants: - Total hip replacement surgery uses implants with several parts: a metal stem for the thighbone, a ceramic or metal ball to replace the damaged femoral head, and a metal socket with a ceramic or plastic lining for the hip socket. These implants

are designed to be durable and compatible with the body, helping to reduce pain, improve movement, and restore quality of life. Modern implants may include advanced features like modular parts or materials with better wear resistance. [8]

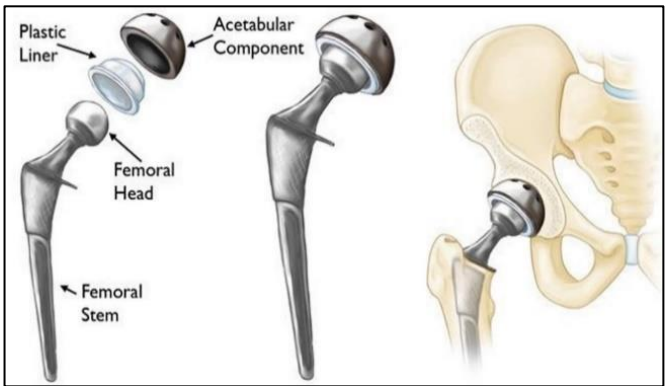

Fig: 11 Hip Joint Implants

Knee Joint Implants: - Known also as knee arthroplasty, knee joint implants are utilized in total knee replacement surgery. Knee joint implants typically consist of three main components: a metal part that replaces the end of the femur, a plastic and metal piece for the top of the tibia, and a plastic spacer between the metal parts for cushioning. Occasionally, a plastic component may also be added to the patella. These implants are designed to replicate the knee's natural movement, enhancing stability, weight-bearing capacity, and range of motion [51,52].

Fig: 12 Knee Joint Implants

SPINAL IMPLANTS:

Pedicle screws: Pedicle screws are small metal projections attached to the vertebrae, used to stabilize the spine during fusion procedures and serve as anchors for other implant parts. Made from titanium or stainless steel, these screws come in various sizes and styles to suit different needs. [29]

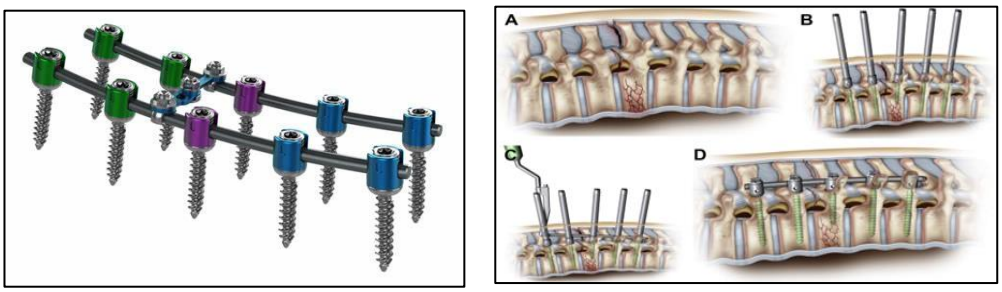

Fig: 13 Pedicle screws

Rods: Metal rods are often used alongside pedicle screws to enhance spine support and alignment. Attached to the screws, these rods help maintain proper spinal curvature and support while the bones fuse. They are typically made from titanium or cobalt-chromium alloys and shaped to match the spine's natural curve. [5]

Interbody implants: Interbody implants are used to fill the space between vertebrae to promote fusion, decompress nerves, and restore disc height. These implants, made from materials like titanium, PEEK, and artificial bone grafts, include cage implants that stabilize the spine and may be filled with bone graft material, and artificial discs that preserve motion in the spinal segment. Additionally, hooks and wires can provide extra stability during spinal fusion procedures alongside pedicle screws and rods.

Fig: 14 Artificial discs

Process of pedicle screw: Patients are kept under observation for problems like as infection or bleeding. There is painkiller available to help with discomfort. Physical therapy improves the mobility and strength of muscles. Appointments for follow-up guarantee adequate healing. Recuperation is aided by activity limitations, such as avoiding heavy lifting.

Aftercare:

After surgery, patients are closely monitored in the hospital for complications like bleeding or infection. Pain management is handled with prescribed painkillers, and physical therapy is recommended to improve mobility and strengthen supporting muscles. Follow-up appointments with the surgeon are scheduled to ensure proper recovery, and patients are advised to avoid heavy lifting and intense activities to allow the spine to heal properly.

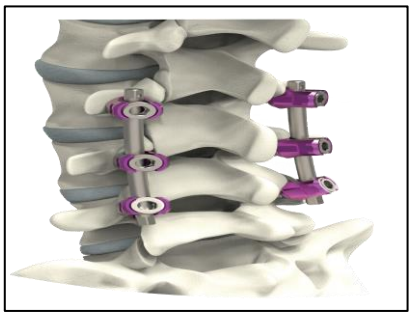

Fig: 15 Pedicle Screw

RENAL DEVICES

Artificial kidneys

Research and development in the field of artificial kidneys continue to advance, with ongoing efforts to improve device performance, biocompatibility, and patient outcomes. While several promising prototypes have been developed, including some that have undergone clinical trials, widespread adoption of artificial kidneys for routine clinical use may require further refinement, regulatory approval, and scalability to meet the growing demand for kidney replacement therapies worldwide.[56,54]

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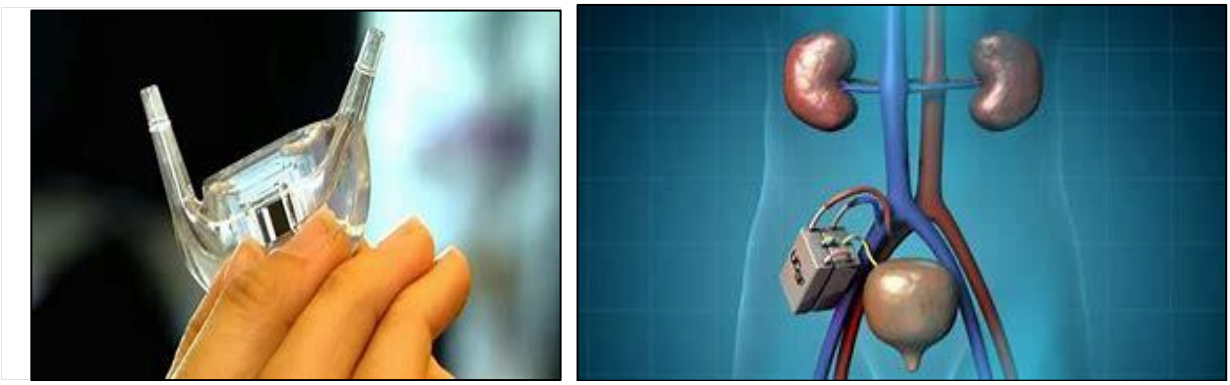

Fig: 16 Artificial kidneys

Renal Assist Device (RAD): A bioartificial kidney combines a membrane hemofilter and a bioreactor with human renal tubule cells to replicate many kidney functions. To develop this technology, three key advancements were necessary: creating efficient ultrafiltration membranes, managing blood-material interactions to prevent issues like clotting, and ensuring stable function of renal cells in the device. Recent progress in silicon nanotechnology, improved blood-compatible coatings, and solutions for cell sourcing and storage have made these developments possible [56].

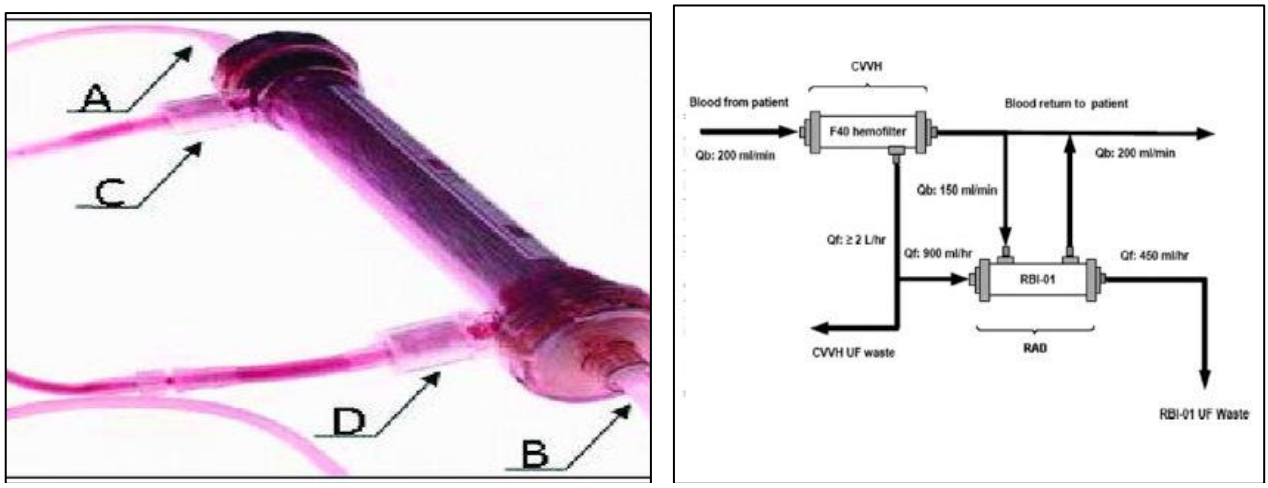

Fig: 17 Renal Assist Device (RAD)

Renal sympathetic denervation (RSDN) is a minimally invasive procedure that uses radiofrequency or ultrasound ablation to treat resistant hypertension. The technique involves destroying nerves in the renal arteries, which reduces sympathetic nerve activity and can lower blood pressure**.** [54,56]

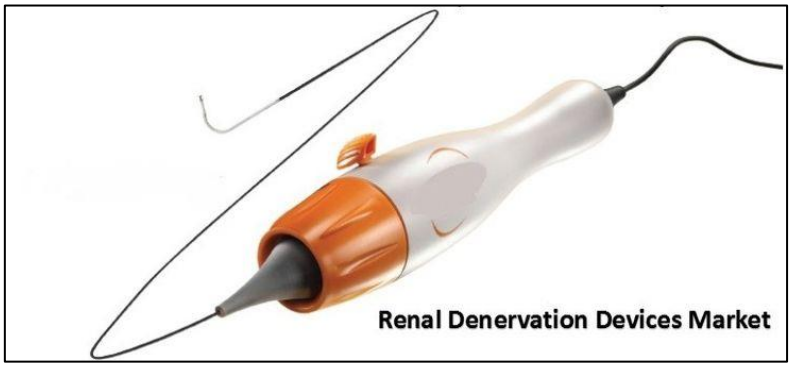

Fig: 18 Renal sympathetic denervation

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Peritoneal Dialysis

To ensure effective peritoneal dialysis and overall well-being, follow these aftercare guidelines: clean the catheter site daily with soap and water to prevent infection, monitor fluid intake as directed, follow a renal-friendly diet, take prescribed medications regularly, attend frequent check-ups, stay active but avoid strenuous activities, and watch for signs of infection around the catheter site. Additionally, seek emotional support from healthcare professionals or support groups to handle any lifestyle changes.

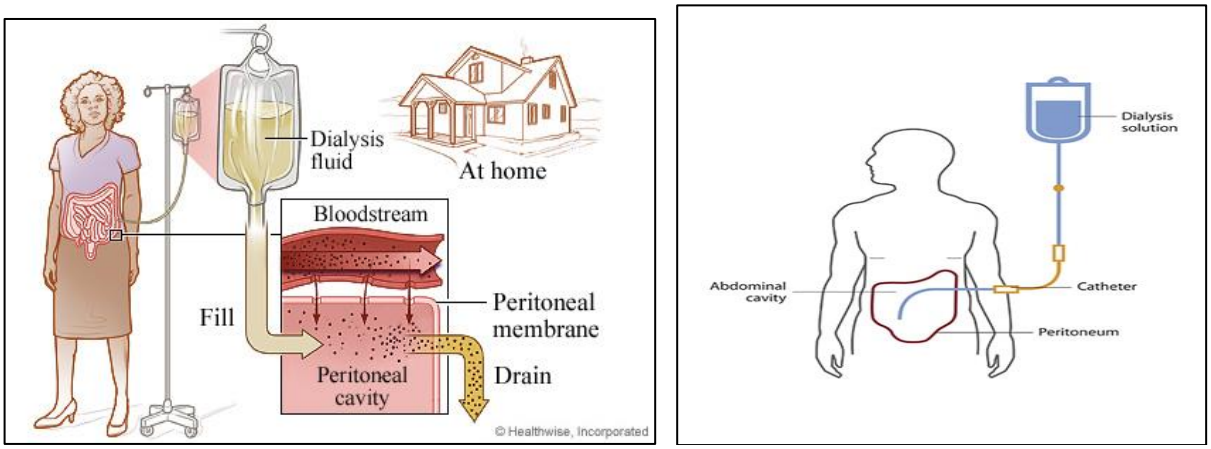

Fig: 19 Peritoneal Dialysis

SURVEY DESIGN

Goals: An implantable medical device survey aims to collect important information about a variety of topics related to these devices, such as their use, performance, security, patient satisfaction, and possible areas for development.

- Compliance Comprehension
- Understanding Usages of Devices
- Understanding Effectiveness
- Safety Of Device
- Patients Outcome

By surveying implantable medical devices, we can improve patient care, increase the safety and efficacy of our devices, and create innovation in the medical technology industry. The survey helps to improve the quality, safety, and results of implantable medical device therapy for patients worldwide by collecting complete and useful data.

Survey Method

Method of Administration: Face-to-Face Surveys

Nature of Questions: Closed-ended Surveys

Open-ended Surveys

Descriptive Surveys

Questioning

Interaction with the Participants

Started by giving a short overview and outlining the goals of the survey. Participants are informed of the value of their input and its intended purpose as a result. This promotes trust and transparency between us.

Comforting participants that their answers will be privatized and kept private in order to maintain their privacy.

At the end of the survey, expressed gratitude to respondents for their participation. Thanking those makes they feel like they made a contribution.

Patient's feedback: -

Awareness and Understanding: Depending on a variety of factors, including education, healthcare exposure, and personal experiences, people's familiarity with implantable medical devices varies significantly.

Experience: People with implanted medical devices may have a variety of experiences, from easy and successful outcomes to difficult and problematic ones. Information from healthcare providers and individual experiences can all have an impact on how safe and effective something is perceived.

Advantages and Drawbacks: Implantable medical devices can lead to better health, more mobility, and a higher standard of living. On the other hand, risks like infection, device failure to function, and long-term complications must also be taken into consideration.

Use and affordability: A number of variables, including financial status, insurance coverage, and the availability of healthcare systems, may have an impact on people's ability to get implanted medical devices. Many people still worry about affordability, especially in areas with few healthcare resources.

Quality of Life: By allowing a person to carry out daily tasks while participating in social activities, implanted medical devices can have significant beneficial effects on a person's quality of life. It may also be influenced by elements like comfort & maintenance.

Regulation and Control: To guarantee the effectiveness, security, and quality of implanted medical devices, regulatory bodies are important. To detect new risks and improve patient safety, ongoing evaluation, and observation are essential.

Patient Education and Support: Large programs of information and support may allow patients to take charge of their own care and make well-informed decisions about implantable medical devices.

Future Development: The development of next-generation implantable medical devices with enhanced features and compatibility is looking bright due to developments in materials science, reduction in size, and the use of wireless technology.

Privacy and Data Security: Strong data protection procedures and legal frameworks are essential because of worries regarding the privacy and security of patient data gathered by implanted medical devices. To address these complex challenges, collaborative efforts involving customers from the technology, policy, and healthcare domains are required.

Conclusion: There is need to Reduced Pain and Symptoms, Greater Independence, Better Quality of Life.

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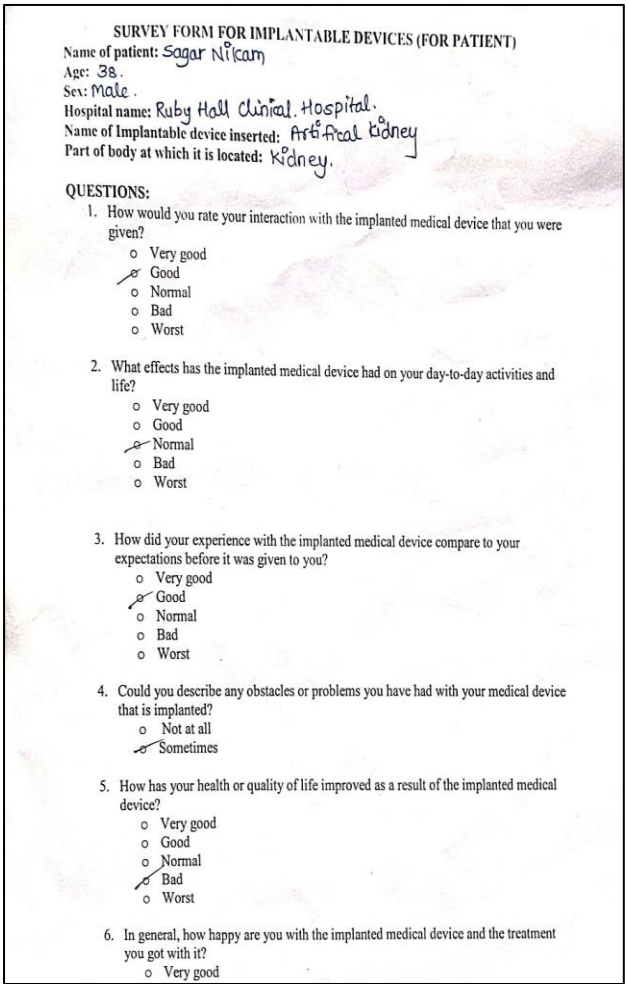


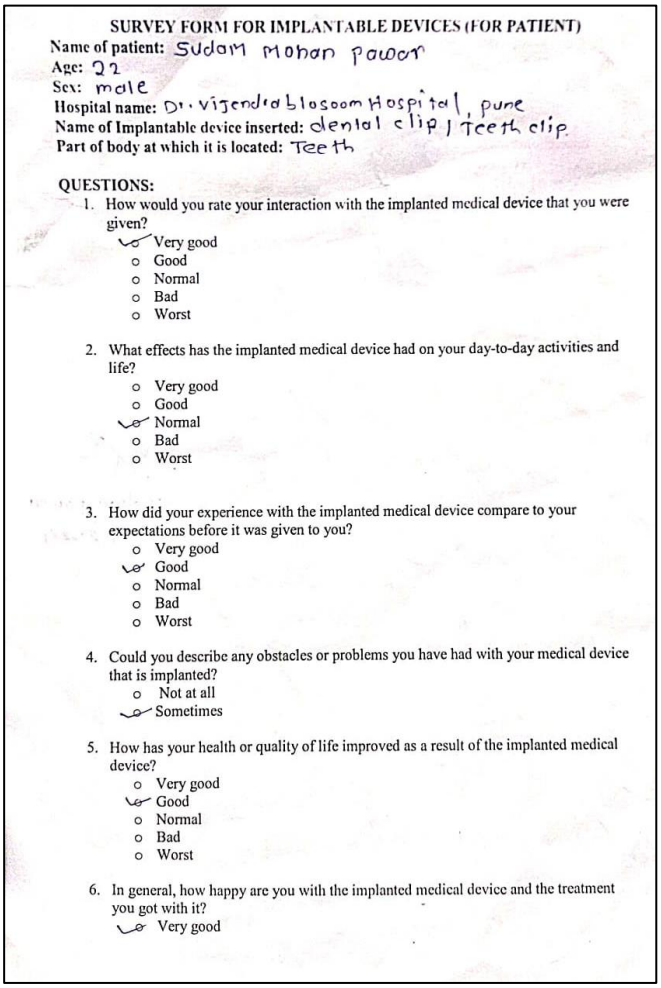
SURVEY FORM FOR IMPLANTABLE DEVICES (FOR PATIENT)

Name of patient: Sagar Nikam
Age: 38.
Sex: Male.
Hospital name: Ruby Hall Clinical Hospital.
Name of Implantable device inserted: Artificial kidney
Part of body at which it is located: Kidney.

QUESTIONS:

1. How would you rate your interaction with the implanted medical device that you were given?
   - o Very good
   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
2. What effects has the implanted medical device had on your day-to-day activities and life?
   - o Very good
   - o Good
   - ✓ Normal
   - o Bad
   - o Worst
3. How did your experience with the implanted medical device compare to your expectations before it was given to you?
   - o Very good
   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
4. Could you describe any obstacles or problems you have had with your medical device that is implanted?
   - o Not at all
   - ✓ Sometimes
5. How has your health or quality of life improved as a result of the implanted medical device?
   - o Very good
   - o Good
   - o Normal
   - ✓ Bad
   - o Worst
6. In general, how happy are you with the implanted medical device and the treatment you got with it?
   - o Very good

Form: 1



SURVEY FORM FOR IMPLANTABLE DEVICES (FOR PATIENT)

Name of patient: Sudam Mohan pawar
Age: 22
Sex: male
Hospital name: Dr. vijendra blossom Hospital, pune
Name of Implantable device inserted: dental clip / Teeth clip
Part of body at which it is located: Teeth

QUESTIONS:

1. How would you rate your interaction with the implanted medical device that you were given?
   - ✓ Very good
   - o Good
   - o Normal
   - o Bad
   - o Worst
2. What effects has the implanted medical device had on your day-to-day activities and life?
   - o Very good
   - o Good
   - ✓ Normal
   - o Bad
   - o Worst
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   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
6. In general, how happy are you with the implanted medical device and the treatment you got with it?
   - ✓ Very good

Form: 2

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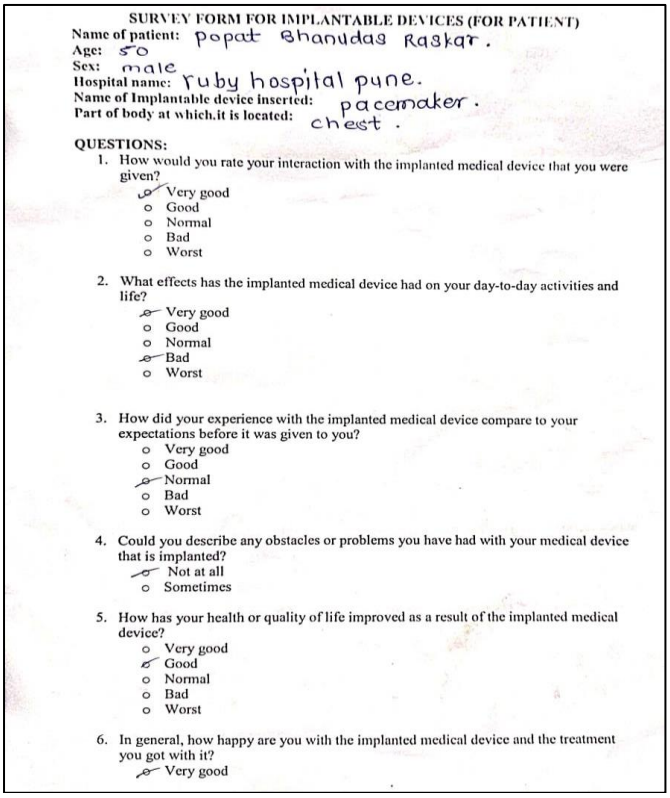

SURVEY FORM FOR IMPLANTABLE DEVICES (FOR PATIENT)

Name of patient: Popat Bhanudas Raskar.
Age: 50
Sex: male
Hospital name: ruby hospital pune.
Name of Implantable device inserted: pacemaker.
Part of body at which it is located: chest.

QUESTIONS:

1. How would you rate your interaction with the implanted medical device that you were given?
   - ✓ Very good
   - o Good
   - o Normal
   - o Bad
   - o Worst
2. What effects has the implanted medical device had on your day-to-day activities and life?
   - ✓ Very good
   - o Good
   - o Normal
   - ✓ Bad
   - o Worst
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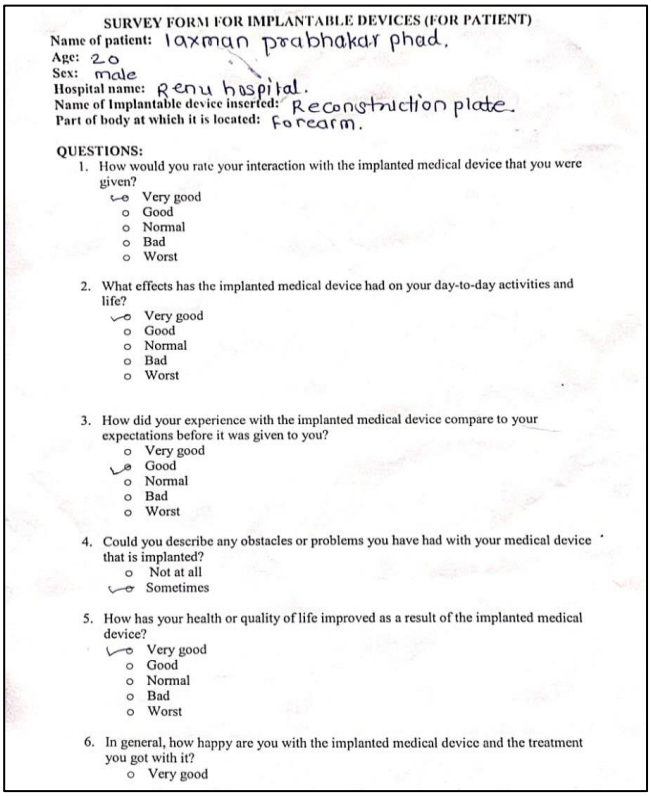
   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
6. In general, how happy are you with the implanted medical device and the treatment you got with it?
   - ✓ Very good

Form:3



SURVEY FORM FOR IMPLANTABLE DEVICES (FOR PATIENT)

Name of patient: laxman prabhakar phad.
Age: 20
Sex: male
Hospital name: Renu hospital.
Name of Implantable device inserted: Reconstruction plate.
Part of body at which it is located: Forearm.

QUESTIONS:

1. How would you rate your interaction with the implanted medical device that you were given?
   - ✓ Very good
   - o Good
   - o Normal
   - o Bad
   - o Worst
2. What effects has the implanted medical device had on your day-to-day activities and life?
   - ✓ Very good
   - o Good
   - o Normal
   - o Bad
   - o Worst
3. How did your experience with the implanted medical device compare to your expectations before it was given to you?
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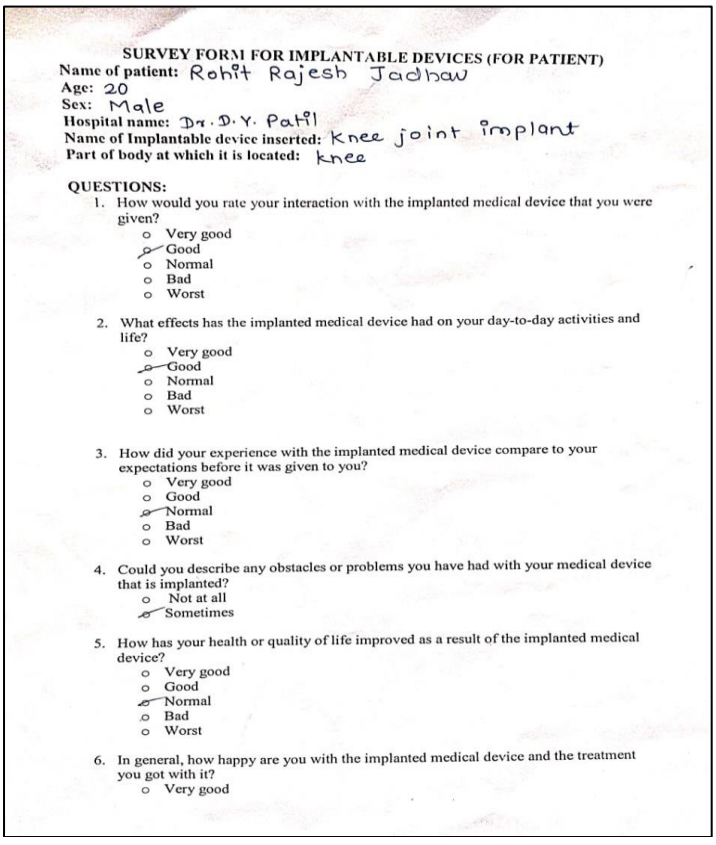
   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
4. Could you describe any obstacles or problems you have had with your medical device that is implanted?
   - o Not at all
   - ✓ Sometimes
5. How has your health or quality of life improved as a result of the implanted medical device?
   - ✓ Very good
   - o Good
   - o Normal
   - o Bad
   - o Worst
6. In general, how happy are you with the implanted medical device and the treatment you got with it?
   - o Very good

Form:4



SURVEY FORM FOR IMPLANTABLE DEVICES (FOR PATIENT)

Name of patient: Rohit Rajesh Jadhav
Age: 20
Sex: Male
Hospital name: Dr. D.Y. Patil
Name of Implantable device inserted: Knee joint implant
Part of body at which it is located: knee

QUESTIONS:

1. How would you rate your interaction with the implanted medical device that you were given?
   - o Very good
   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
2. What effects has the implanted medical device had on your day-to-day activities and life?
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   - ✓ Good
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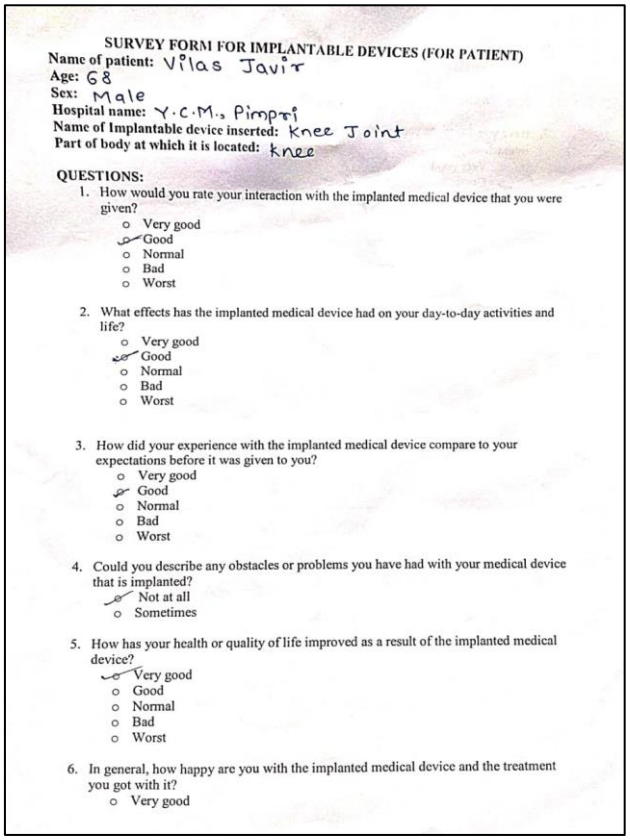
   - ✓ Sometimes
5. How has your health or quality of life improved as a result of the implanted medical device?
   - o Very good
   - o Good
   - ✓ Normal
   - o Bad
   - o Worst
6. In general, how happy are you with the implanted medical device and the treatment you got with it?
   - o Very good

Form: 5



SURVEY FORM FOR IMPLANTABLE DEVICES (FOR PATIENT)

Name of patient: Vilas Javir
Age: 68
Sex: Male
Hospital name: Y.C.M., Pimpri
Name of Implantable device inserted: Knee Joint
Part of body at which it is located: knee

QUESTIONS:

1. How would you rate your interaction with the implanted medical device that you were given?
   - o Very good
   - ✓ Good
   - o Normal
   - o Bad
   - o Worst
2. What effects has the implanted medical device had on your day-to-day activities and life?
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   - ✓ Not at all
   - o Sometimes
5. How has your health or quality of life improved as a result of the implanted medical device?
   - ✓ Very good
   - o Good
   - o Normal
   - o Bad
   - o Worst
6. In general, how happy are you with the implanted medical device and the treatment you got with it?
   - o Very good

Form: 6

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Interaction with the Doctors: In your experience, what are the most common types of implantable medical devices that patients receive?

1. How do you typically decide whether a patient is a suitable candidate for an implantable medical device?

2. Can you share any notable success stories or positive outcomes from patients who have received implantable medical devices under your care?

3. What are some of the main challenges or complications you have encountered when implanting medical devices in patients?

4. How do you respond to patient worries or doubts regarding the use of an implanted medical device?

5. How are patients followed up and monitored once they receive an implanted medical device?

6. In your opinion, what are the main elements that, make implantable medical devices successful for patients over the long term?

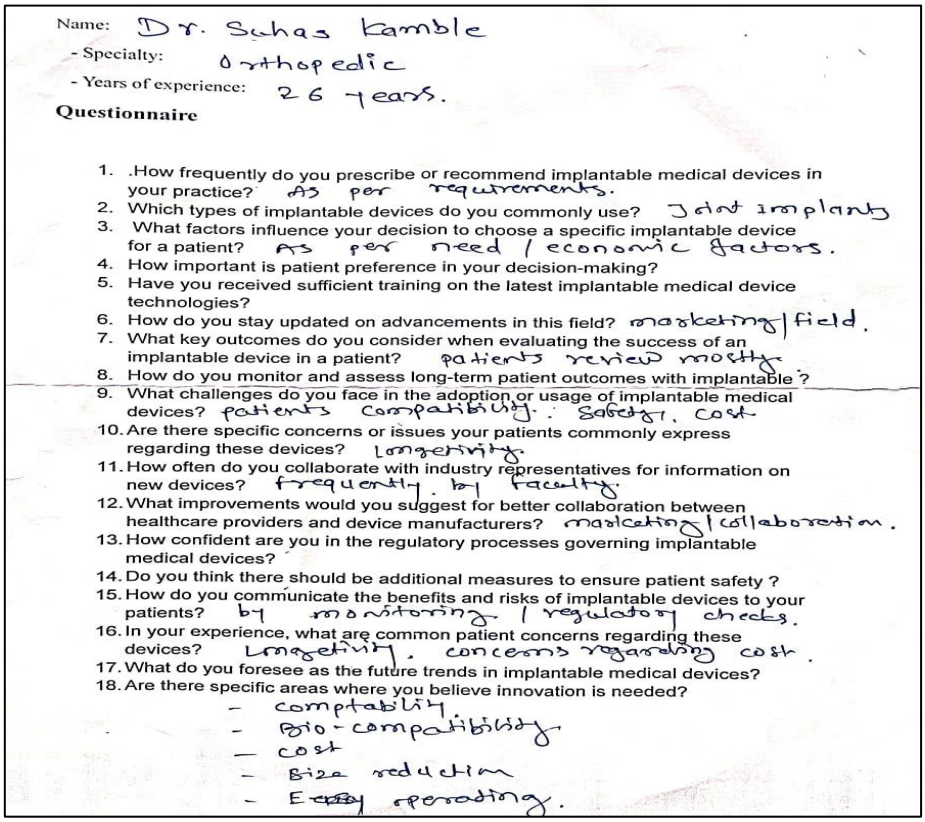
7. Have you seen any developments in implantable medical device technology that have enhanced surgical techniques or the results for patients?

8. What are your thoughts on patient education and informed consent regarding implantable medical devices?

9. How can you make sure patients are well-informed about the procedure before they go through with it?

Doctor's feedback: -

Pacemakers, implantable cardioverter-defibrillators (ICDs), neurostimulators for conditions like Parkinson's disease or chronic pain, implantable pumps for delivering drugs, cochlear implants for hearing loss, and different orthopaedic implants like hip or knee replacements are among the most popular kinds of implantable medical devices.



Name: Dr. Suhas Kamble
- Specialty: Orthopedic
- Years of experience: 26 years.

Questionnaire

1. .How frequently do you prescribe or recommend implantable medical devices in your practice? As per requirements.
2. Which types of implantable devices do you commonly use? Joint implants
3. What factors influence your decision to choose a specific implantable device for a patient? As per need / economic factors.
4. How important is patient preference in your decision-making?
5. Have you received sufficient training on the latest implantable medical device technologies?
6. How do you stay updated on advancements in this field? marketing/field.
7. What key outcomes do you consider when evaluating the success of an implantable device in a patient? patients review mostly.
8. How do you monitor and assess long-term patient outcomes with implantable?
9. What challenges do you face in the adoption or usage of implantable medical devices? patients compatibility. Safety, cost.
10. Are there specific concerns or issues your patients commonly express regarding these devices? Longevity.
11. How often do you collaborate with industry representatives for information on new devices? frequently. by faculty.
12. What improvements would you suggest for better collaboration between healthcare providers and device manufacturers? marketing/collaboration.
13. How confident are you in the regulatory processes governing implantable medical devices?
14. Do you think there should be additional measures to ensure patient safety ?
15. How do you communicate the benefits and risks of implantable devices to your patients? by monitoring / regulatory checks.
16. In your experience, what are common patient concerns regarding these devices? Longetivity. concerns regarding cost.
17. What do you foresee as the future trends in implantable medical devices?
18. Are there specific areas where you believe innovation is needed?
    - comptability.
    - Bio-compatibility.
    - cost
    - Size reduction
    - Easy operating.

Form:1

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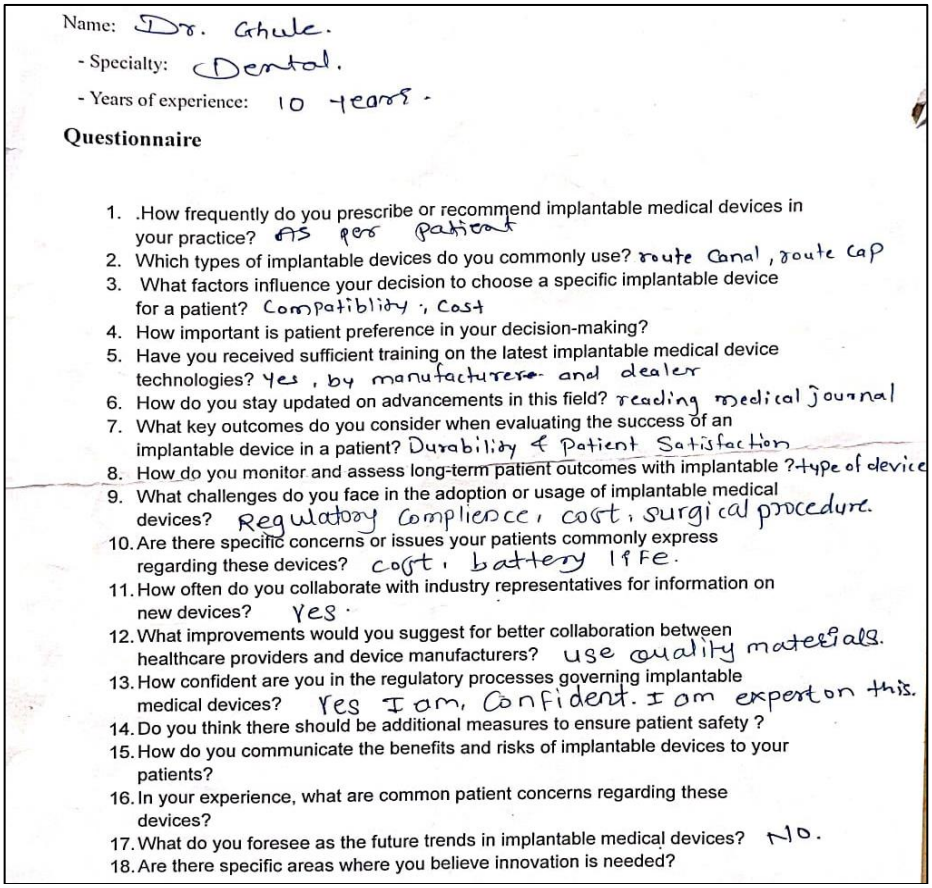

Name: Dr. Ghule.
- Specialty: Dental.
- Years of experience: 10 years.

Questionnaire

1. .How frequently do you prescribe or recommend implantable medical devices in your practice? As per patient
2. Which types of implantable devices do you commonly use? route Canal, route Cap
3. What factors influence your decision to choose a specific implantable device for a patient? Compatibility, Cost
4. How important is patient preference in your decision-making?
5. Have you received sufficient training on the latest implantable medical device technologies? Yes, by manufacturers and dealer
6. How do you stay updated on advancements in this field? reading medical journal
7. What key outcomes do you consider when evaluating the success of an implantable device in a patient? Durability & Patient Satisfaction
8. How do you monitor and assess long-term patient outcomes with implantable ?-type of device
9. What challenges do you face in the adoption or usage of implantable medical devices? Regulatory Compliance, cost, surgical procedure.
10. Are there specific concerns or issues your patients commonly express regarding these devices? cost, battery life.
11. How often do you collaborate with industry representatives for information on new devices? Yes.
12. What improvements would you suggest for better collaboration between healthcare providers and device manufacturers? use quality materials.
13. How confident are you in the regulatory processes governing implantable medical devices? Yes I am, Confident. I am expert on this.
14. Do you think there should be additional measures to ensure patient safety ?
15. How do you communicate the benefits and risks of implantable devices to your patients?
16. In your experience, what are common patient concerns regarding these devices?
17. What do you foresee as the future trends in implantable medical devices? No.
18. Are there specific areas where you believe innovation is needed?

Form:2

OBSERVATIONS:

The goal of this survey is to learn more about how patients and healthcare providers use implantable medical devices, how satisfied they are with them, and what problems they manage. Modern healthcare relies heavily on implantable medical devices, which include orthopaedic implants, defibrillators, and pacemakers.

A report presentative sample of patients who have had procedures involving implantable medical devices as well as medical professionals involved in their prescription, implantation, or handling were the target audience for the offline survey. 30 healthcare professionals and 40 patients made up the total number of respondents who took part in the survey. Because of the smaller sample size, data collection and analysis could be more focused.

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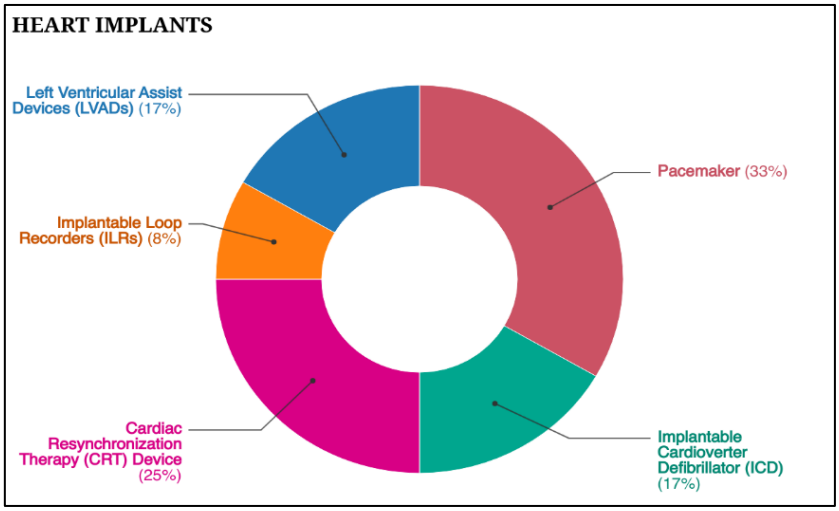

Fig.: 20 HEART IMPLANTS

Table 1: Data of heart implantable devices

Sr. No	Name of devices	No. of Patient
1	Pacemaker	3
2	ICD	2
3	CRT	3
4	ILRs	1
5	LVADs	2
	TOTAL	**12**

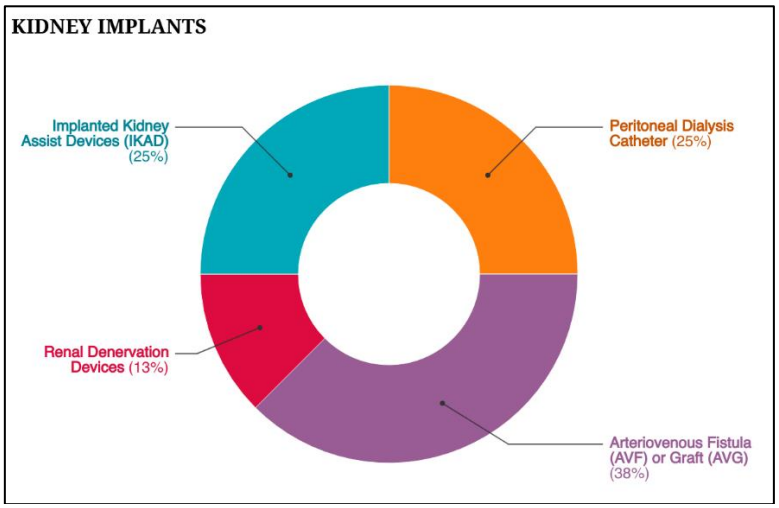

Fig.: 21 KIDENY IMPLANTS

Table 2: Data of kidney implantable devices.

Sr.No	Name of the Device	No. of Patient
1	Peritoneal Dialysis	2
2	Arteriovenous Fistula	3
3	Renal Denervation Devices	1
4	Implanted Kideny Assist Devices	2
	TOTAL	**8**

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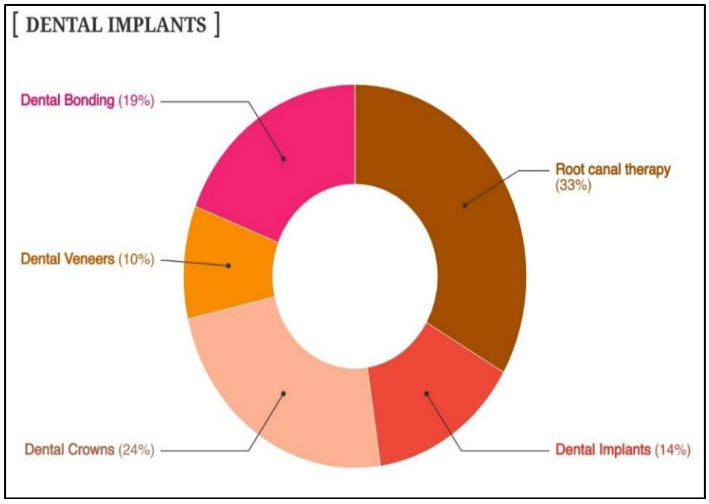

Fig.: 22 DENTAL IMPLANTS

Table 3: Data of Dental implantable devices.

Sr.No	Name of the Device	No. of Patient
1	Root canal therapy	7
2	Dental implant	3
3	Dental crown	5
4	Dental veneers	2
5	Dental bonding	4
	TOTAL	**21**

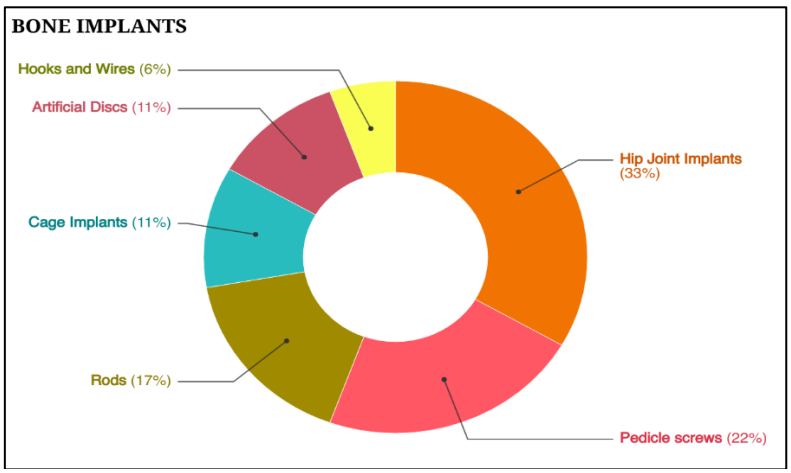

Fig.: 23 BONES IMPLANTS

Table 4: Data of bones implantable devices.

Sr.No	Name of the Device	No. of Patient
1	Hip Joint implant	6
2	Pedicle screw	4
3	Rods	3
4	Cage implants	2
5	Artificial discs	2
6	Hooks and Wires	1
	TOTAL	**18**

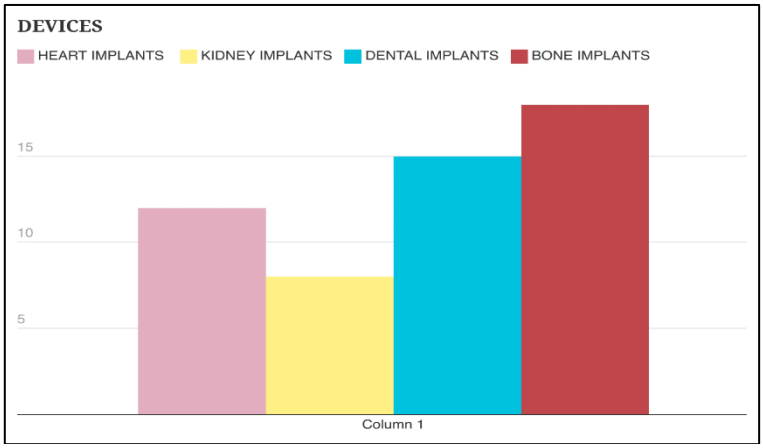

Fig.: 24 Analysis of survey

CONCLUSION:

From the above survey, we can conclude that, Development is informed by patient surveys, which highlight user preferences related to cost, longevity, usage, safety and dependability. Future implantable medical devices will be shaped by emerging technology and cooperation, openness, performance and cost effectiveness will be fuelled by competitor analysis and stakeholder input.

FUTURE PROSPECTIVE

As indicated by the survey the development of implanted medical devices (IMDs) critically depends on future factors. These include biocompatible materials to lessen unpleasant responses, wireless connectivity for remote monitoring, downsizing for less invasive procedures, and smart sensors for ongoing diagnostics. Personalized medicine and long-lasting components ensure optimal therapeutic results. Predictive analytics is made possible by AI, and bioresorbable implants and regenerative methods support tissue healing. Reliance on external power sources is decreased by energy collection. The quality of life and patient outcomes are enhanced by these advancements.

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