Saint Joseph University in Tanzania

Dar es Salaam, Tanzania

Research Agenda

November 2024

Table of Content

1.0 INTRODUCTION

1.1 Background

Research is creative and systematic enquiry and analysis undertaken to increase the stock of knowledge. It involves the collection, organisation and analysis of evidence to increase the understanding of a topic, improve performance or create new devices, equipment or systems that will improve the quality of life for mankind. It may be empirical or theoretical, quantitative or Qualitative, applied or basic.

Research aims at complementing efforts of a country towards creating, disseminating and sharing existing and new knowledge and utilizing products, processes and services more effectively.The major goal of research is to serve as an instrument of change to improve people's living standards by stimulating growth and increase productivity in critical sectors of the economy.

Research may involve the critique of policy; in-depth analysis of regularly compiled data sets and explanations of trends and observations. Rigorous evaluation studies of educational and training programmes or interventions, including cost-benefit analyses and impact studies, fall under the research umbrella, as do high level analyses of statistical data.
Research can lead to

- ✓ the creation of more competitive products and services,
- ✓ improvement of people's quality of life,
- ✓ the increase of food production,
- ✓ improvement of security and shelter

In engineering and technology research can bring about

- ✓ new products through innovations,
- ✓ better product improvement,
- ✓ better enhanced service efficiency,
- ✓ effectiveness and improved performance of products in the market place.

It is obvious that the benefits of research to a nation's development is large but the research activities in Tanzania are limited. Most of existing research activities in the country are those that are carried out in isolation, with most of them failing to address national priorities.

1.2 Rationale for Research Agenda

The biggest roles of any University are teaching, learning and research. These roles complement each other. Teaching and learning provides the necessary foundation for research while research enhances teaching and learning. Since its launch in 2003, St Joseph University in Tanzania has built capacity in teaching and learning at undergraduate levels. It is now time for the University to build research and postgraduate capacity.

A research agenda will help to redirect the SJUIT effort into research within a clear University framework as well as within national priorities.

This Research Agenda sets out the research needs of the SJUIT for the period 2025 to 2028. It has been developed to support research planning at SJUIT and to signal to stakeholders the areas of research that SJUIT has identified as being important.

More specifically, the Research Agenda has been developed to:

a) inform planning and implementation processes within the University

b) inform stakeholders of the research priorities;

c) signal to funders and development partners what research areas require investment, and

d) assist the University to guide resource allocation for research.

It is hoped that the Research Agenda will be used by researchers, research organisations and post-graduate students to inform their research planning. It will also be used to create research teams that could be funded centrally.

Thus this research agenda will act as a guiding tool to ensure fair selection of identified research needs and priorities in order make informed management choices and decisions in terms of allocation of resources.

SJUIT has two Colleges; the Saint Joseph College of Engineering and Technology (SJCET) and Saint Joseph College of Health and Allied Sciences (SJCHAS). The main research theme for SJCET will be **Green Technology** and the main theme for SJCHAS will b**e "Health and Allied Sciences"**

2.0 St Joseph College of Engineering and Technology

2.1 The Main Research Theme: Green Technology

Green technology refers to the development and use of technologies that minimize the negative impacts of human activities on the environment and society. It encompasses a wide range of products, services and practices that support a more sustainable future. Often known as "**Green Tech,**" the concept is gaining attention as the world seeks ways to address issues that cause climate change and its consequences. The creators of green technology use scientific knowledge and innovation to help conserve natural resources, reduce greenhouse gas emissions and promote the use of renewable energy.

2.2 Key Requirement of Green Technology

Green technology solutions are meant to be sustainable; they are designed to meet the needs of the present without compromising the ability of future generations to meet their own needs. They should limit environmental impact in various ways, and focus on energy efficiency.

Green tech strategies consider the entire lifecycle of a product or service, from raw material extraction to end-of-life disposal. Their proponents aim to understand the full environmental impact of their activities. They also recognize the social implications of technological development, promoting social equity and well-being. These implications include considering the impact of technology on local communities, workers and consumers, and striving to create innovative solutions that benefit society as a whole.

2.3 The Importance of Green Technology

Green technology initiatives play an important role in addressing climate change. Greenhouse gas emissions from human activities (such as burning of fossil fuels and deforestation) are producing unprecedented levels of carbon dioxide in the Earth's atmosphere. These concentrations lead to global warming and its consequences, including rising sea levels, extreme weather events and ecosystem disruption. According to the Intergovernmental Panel on Climate Change (IPCC), immediate steps must be taken to limit global warming to 1.5°C (34.7°F) above preindustrial levels.

Adopting sustainable technologies can help mitigate emissions and reduce the carbon footprints of countries and companies. They can conserve resources, preserve biodiversity and reduce pollution. But the benefits of green technology extend beyond environmental protection of ecosystems. Below we have identified some research areas that focus on public health, forest fires,energy efficient systems,Weather Monitoring and Early warning Technologies, Renewable energy and Waste management. In each of these technologies the potential to make a difference in climate change exists.

On December 1–4, 2019, the 2nd Green Technologies for Sustainable Water Conference (GTSW 2019) held in Ho Chi Minh City, Viet Nam identified the following themes involving green technologies:

(1) water and wastewater treatment
(2) wastewater treatment and reuse,
(3) membrane processes,
(4) resources recovery from wastewater,
(5) nanotechnology for biological waste treatment,
(6) bio-processes and bio-products, and
(7) disruptive technologies and the application for water resource treatment and management

These are the current research themes on green tech at the international arena.

3.0 Research Areas By Clusters

This section summarises selected structured research needs and priorities that have been identified by researchers within the SJCET that are likely to address societal challenges in a comprehensive manner. These clusters point out areas of relevance, priority and multidisciplinary advantage for

articulation towards future 'targeted' purposes in investigation and innovation. The outcome of research from these clusters will enable the university and the country at large to play its rightful role.

3.1 Mechanical, Mechatronics and Industrial Engineering (MMIE: COE 1)

3.1.1 Energy Efficient Systems

Energy efficiency is the use of less energy to perform the same task or produce the same result. Energy-efficient homes and buildings use less energy to heat, cool, and run appliances and electronics, and energy-efficient manufacturing facilities use less energy to produce goods.

Energy efficiency is one of the easiest and most cost-effective ways to combat climate change, reduce energy costs for consumers, and improve the competitiveness in businesses. Energy efficiency is also a vital component in achieving net-zero emissions of carbon dioxide through de-carbonization.

The focus of this group is to design electronics, electrical and communication devices, equipment and/or systems, that are energy efficient. Energy efficient devices will limit the dependability on fossil fuels and thus the emission of carbon dioxide. In this research the candidates must build an energy efficient hybrid car that will use electricity and switch over to batteries with the intention of optimising cost.

3.1.2 Research Topics

1) Design a system to measure the fuel efficiency of a car. Study the fuel efficiency of a petrol engine and gas engine cars.
2) Design a system to measure the CO_2 emission for any car. Study CO_2 emissions from a sample of Tanzanian cars.
3) Convert a petrol engine car to an electric car and assess the benefits.
4) Implement energy assessment and improvements, and the use of renewable energy systems in buildings (homes and industrial) in Tanzania.
5) Implement an audit on the performance of renewable energy sources

3.1.3 Stakeholders

Key players for this cluster will include engineers, scientists, social scientists, communities, policy makers, technologists, car owners, entrepreneurs, students, researchers

3.1.4 Expected Outputs

Fuel efficiency meter, CO_2 emission meter, Electric car prototype, Use of renewable Energy in Buildings, Project reports, Dissertation reports

3.1.5 Duration of the Project

Two years

3.2 Science, Mathematics, with Education (MEdu: COE 2)

3.2.1 Agriculture

Smart farming and sustainable agriculture practices aim to reduce the environmental impact of food production and maintain food security. Examples include precision agriculture, which uses data and sensors to optimize resource use, and vertical farming, which grows crops in stacked layers and uses LED lighting and hydroponic systems.
Recently, technologies used for smart farming have extended to Artificial Intelligence (AI), Automation and the Internet of Things (IoT).

AI-powered predictive analytics is already paving the way into agribusinesses. Farmers can gather and process more data in less time with AI. Additionally, AI can analyse market demand, forecast prices as well as determine optimal times for sowing and harvesting.

These innovations are becoming increasingly essential as global challenges such as climate change, population growth together with resource scarcity threaten the sustainability of our food system. Introducing AI solves many challenges and helps to diminish many disadvantages of traditional farming.

Automated farm machinery like driverless tractors, smart irrigation, fertilization systems, IoT-powered agricultural drones, smart spraying, vertical farming software, and AI-based greenhouse robots for harvesting are just some examples. Compared with any human farm worker, AI-driven tools are far more efficient and accurate.

3.2.2 Research Topics

1) Develop a demonstration for a smart farm using AI and IoT. Try to determine the level of impact for each resource applied and for that reason try the combination to get the optimum performance on plant growth
2) Repeat 1 for a hydroponic system
3) Use drones to monitor a farmstead.

3.2.3 Stakeholders

Key players for this cluster will include farmers, engineers, scientists, social scientists, communities, policy makers, entrepreneurs, students, researchers.

3.2.4 Expected Outputs

Smart farm prototype, smart hydroponic system, project report, dissertation report

3.2.5 Duration

Two years

3.3 Science, Mathematics, with Education (MEdu: COE 2)

3.3.1 Carbon Capture Technologies

Carbon capture and storage involves capturing carbon dioxide (CO_2) emissions from industrial processes or the atmosphere and storing them permanently to prevent their release into the atmosphere. Other carbon capture technologies include direct air capture systems that remove CO_2 directly from the air. The category also includes high-energy with carbon capture and storage, which combines biomass energy production with CO_2 capture and storage.

3.3.2 Research Topics

1) Review with, analysis, the Carbon Capture technologies and recommend the most feasible and economical that can be applied in a developing country. Develop a prototype.
2) Review the use of Captured CO_2. Develop a demonstration of an application.
3) Make an audit of CO_2 emissions in Tanzania.

3.3.3 Stakeholders

Key players for this cluster will include engineers, scientists, social scientists, communities, policy makers, farmers, entrepreneurs, students, researchers, environmentalists.

3.3.4 Expected Outputs

A prototype for Carbon capture system, A demonstration for CO_2 use, Project report, dissertation report.

3.3.5 Duration

Two years

3.4 Civil Engineering and the Built Environment (CEBE: COE 3)

3.4.1 Waste Management

A waste management system is a streamlined process that organizations use to dispose of, reduce, reuse, and prevent waste. Also known as waste disposal, it is an approach where companies implement comprehensive strategies to efficiently manage wastes from their origin until their final disposal.

Waste can be categorized into various types based on origin, composition, and biodegradability. The main types of waste include

- ✓ **Organic Waste** – this refers to waste that decomposes naturally and can be composted into nutrient-rich soil such as food scraps, yard trimmings, paper, cardboard, and some plastics.
- ✓ **Hazardous Waste** – this refers to waste that has dangerous properties and can be harmful in small amounts such as chemicals, batteries, medical waste, and other materials needing special handling.

- ✓ Solid Waste – this encompasses everyday discarded items such as packaging, food scraps, clothing, and household goods.
- ✓ **Liquid Waste** – these are waste from households, industries, and medical facilities such as wastewater, oil, and chemicals that can contaminate drinking water sources and water bodies.
- ✓ **Recyclable Waste** – waste that consists of materials like plastics, paper, glass, and metals which can be reprocessed to conserve natural resources and minimize environmental impacts.

Green technology can help make the disposal of waste more sustainable. Waste management technologies include advanced recycling facilities that convert waste into valuable resources, such as energy or raw materials for manufacturing. They also include waste-to-energy systems that use controlled incineration to convert waste products into power. The research will focus on the application of required technologies to manage waste.

3.4.2 Research Topics

1) Give a thorough review of waste management technologies. Which is more feasible and economical? Build a prototype for a system you would recommend for a developing country.
2) Make an audit of the Management of Hospital Waste in Dar es Salaam.
3) Make an audit and assess the impact of industrial waste in Dar es Salaam.
4) Make an audit of the Dawasa wastewater management in Dar es Salaam to include collection and processing. What improvement can be made to the wastewater system?
5) Apply new advances in technology, such as AI, Automation and IoT, to design a modern waste management system for a selected Municipality in Dar es Salaam

3.4.3 Stakeholders

Key players for this cluster will include Dawasa, engineers, scientists, social scientists, communities, policy makers, students, researchers, environmentalists.

3.4.4 Expected Outputs

Reports on waste management technologies, Audit Reports on hospital waste, industrial waste, Dawasa wastewater management. A prototype of a modern waste management system.

3.4.5 Duration

Two years

3.5 Civil Engineering and the Built Environment (CEBE: COE 3)

3.5.1 Sustainable Building Construction

The construction sector is a considerable consumer of natural resources and raw materials, with a strong need for business sustainability strategies. According to the World Green Building Council, the industry generates an estimated 39 percent of the world's carbon emissions.

Sustainable construction is a form of construction that seeks to reduce the adverse social, environmental, and economic effects of building construction. The construction methods are designed to achieve several objectives, such as reducing waste and the use of natural resources. The 7 principles of sustainable construction were introduced, as a result of initiatives like the Paris Agreement of 2015 and the 'building to net zero' scheme. Together, the 7 principles offer a framework for the built environment, giving the construction sector a sustainability insight into how to minimise the industry's overall carbon footprint. The 7 principles are

1) The practice of designing to minimize adverse environmental impact.
2) Building with durability and emphasizing the use of construction techniques and robust materials that can withstand the test of time.
3) Use design techniques and strategies utilised to curb energy use during the planning, building, and maintenance of any construction project or building.
4) Apply the waste reduction principle and use recycled materials
5) Strive to improve indoor air quality to promote comfortable and healthy indoor environments.
6) Minimize water consumption
7) Use sustainable building materials

Sustainable construction, using Green building technologies, reduce the environmental impact of the construction and operation of buildings. Examples include energy-efficient design, green roofs and the use of sustainable materials, such as bamboo or recycled steel. These practices help reduce energy consumption, water usage and waste generation in buildings.

3.5.2 Research Topics

1) Make a survey to determine whether the building construction industry adheres to the principle of sustainable building construction.
2) Make a survey of locally available building materials that can be used to construct sustainable buildings.
3) Design a building that abides by the 7 principles of sustainable construction.

3.5.3 Stakeholders

Key players for this cluster will include engineers, constructors, scientists, social scientists, communities, policy makers, entrepreneurs, students, researchers, environmentalists.

3.5.4 Expected Outputs

Reports on the Status of construction in Tanzania, Identification of materials for sustainable construction, Report on issues of using the 7 principles of sustainable construction, dissertation and project reports.

3.5.5 Duration

Two years

3.6 Electrical Electronics and Communication Engineering (EECE: COE 4)

3.6.1 Forest Fires

A 2016 study found climate change enhanced the drying of organic matter and this caused many pockets of wild fires in he United States. Whereas in Tanzania “A wildfire that officials thought was under control on Africa's highest peak, Mount Kilimanjaro was reignited. The blaze began on Friday evening near the Karanga site used by climbers ascending the famous peak, at about 4,000 metres (13,000 feet) altitude on its south side. Hard winds helped fan the fire but a team of some 400 people, including students and volunteers, battled to contain it on Sunday before it lit up in other pockets” 2022 This was serious deforestation and carbon dioxide pollution.

It is important that our research focuses also on Forest Fires. Forest fires not only destroy the forest but produce a huge amount of carbon dioxide and thus enhance the green-house effects. Here research can focus on design and implementation of early detection and rapid response technology to control forest fires.

In 2024, smart smoke detectors not only alert you with a loud noise but also send real-time notifications to your phone, taking home safety to the next level.

3.6.2 Project Topics

1) Assess the performance of existing smoke detectors
2) Design and construct an early fire detection system.
3) Design and Construct a smart fire detection and extinguisher system

3.6.3 Stakeholders

Key players for this cluster will include engineers, constructors, scientists, social scientists, communities, policy makers, entrepreneurs, students, researchers, environmentalists.

3.6.4 Expected Outputs

Prototype of an early smoke detector, fire detector, smart fire detector and extinguisher
Project report

3.6.5 Expected Duration

One year

3.7 Electrical Electronics and Communication Engineering (EECE: COE 4)

3.7.1 Transportation

Electric cars, trucks and buses that are powered by rechargeable batteries help reduce emissions from fossil fuels. Biofuels and alternative low-carbon fuel technologies also fall into this category. Advancements in public transportation and urban infrastructure to support electric vehicles (EVs), bicycle and foot transit are also part of this effort. Develop more efficient batteries that can last longer and carry more charge.

3.7.2 Project Topics

1) Design and Construct a battery that can retain charge for a longer duration of a motor cycle ride
2) Design a bajaji that is powered by battery charged using solar power.
3) Design an app programme that will control traffic lights from a cell phone. It should be possible to manage the lights sequence from a cell phone.

3.7.3 Stakeholders

Key players for this cluster will include engineers, scientists, social scientists, communities, policy makers, entrepreneurs, students, researchers, environmentalists.

3.7.4 Expected Outputs

Prototypes, dissertation and project reports.

3.7.5 Expected Duration

Two years

3.8 Computer Systems and Information Systems Engineering (CSISE: COE 5)

3.8.1 Carbon Tracking Software

Carbon tracking software helps organizations monitor, measure and report their greenhouse gas emissions. These tools enable companies to identify emission hotspots, set reduction targets and track progress toward sustainability goals. Examples include carbon accounting platforms, risk management solutions and supply chain management software that incorporates emissions data. Related solutions

3.8.2 Project Topics

1) Design an app to work with your android phone to monitor, measure and report greenhouse gas emissions. Sensors for the detection of the emissions are necessary.
2) Design a data centre for Carbon Emission monitor.

3.8.3 Stakeholders

Key players for this cluster will include engineers, scientists, social scientists, communities, policy makers, entrepreneurs, students, researchers, environmentalists.

3.8.4 Expected Outputs

Ability to identify emission hotspots, Data centre for Carbon emission monitor, Project reports and dissertation reports

3.8.5 Expected Duration

Two years

3.9 Computer Systems and Information Systems Engineering (CSISE: COE 5)

3.9.1 Weather Monitoring and Early warning Technologies

Of recent several parts of Tanzania has been faced with heavy rains and unpredictable rainy seasons. This has led to deaths of human beings, animals and loss of properties. An effective methods for early warning of impending bad weather need to be researched on and developed.

3.9.2 Project Topics

1) Design and implement a system to receive weather satellite pictures and display from existing weather satellites.
2) Design and implement a microwave system for a point-to-point weather transmission from SJUIT to a school nearby.

3.9.3 Stakeholders

Key players for this cluster will include engineers, farmers, scientists, social scientists, communities, policy makers, entrepreneurs, students, researchers, environmentalists.

3.9.4 Expected Outputs

Prototypes, dissertation and project reports.

3.9.5 Expected Duration

Two years

4.0 St Joseph College of Health and Allied Sciences

4.1 The Main Research Theme: 5P Medicine

SJCHAS has two parts: the School of Medicine (SoM) and Diploma programmes (ODP and ODN). Their research focus will be medicine and allied health sciences, respectively. SJCHAS has selected a main research study on **5P Medicine**.

The concept of 5P medicine is a modern approach to medicine that focuses on personalised, predictive, preventive, cause-oriented—and partner-based treatment. It is a healthcare model that

integrates the latest advances in genetics, bioinformatics, technology and data in order to maintain public health as effectively as possible, minimising the risks of diseases.
The main components of the concept:

4.1.1 Personalized Medicine

Personalised medicine means that the treatment and prevention of diseases are adapted, taking into account the unique characteristics of each patient: his genetic information, lifestyle, health status, preferences and risk factors. Modern technologies such as genomics and bioinformatics make it possible to create individual treatment plans for each person, significantly increasing the effectiveness of medical intervention.

4.1.2 Predictive Medicine

Predictive medicine is based on data to predict the likelihood of disease in a particular person. This is possible due to the analysis of genetic information, medical history, lifestyle and other factors. Based on predictions, it is possible to identify hidden risks and apply preventive measures before the disease develops. For example, predicting the risk of cardiovascular disease or cancer allows one to start preventive treatment or change lifestyle before symptoms appear.

4.1.3. Preventive Medicine

Preventive medicine is an approach aimed at preventing the occurrence of diseases rather than treating them. This includes vaccination, screening (examinations to detect diseases in the early stages), educational programs on a healthy lifestyle, as well as the adjustment of risk factors such as malnutrition, lack of physical activity and stress. Preventive medicine helps to reduce morbidity and mortality, as well as reduce the burden on the health care system as a whole.

4.1.4 Causal-oriented treatment (Participatory Medicine)

This principle emphasises the importance of the patient's active participation in the treatment process. Patients become not just recipients of medical services but active participants in the process, taking part in making decisions about their treatment. This may include electronic medical records, mobile applications for health monitoring, and online consultations with doctors. Doctors, in turn, become guides of knowledge and recommendations, helping patients to choose the appropriate treatment consciously.

4.1.5. Partnership (Partnering)

5P medicine is based on partnerships between patients, medical professionals, scientists and society. It is an approach in which medical professionals and patients work together to achieve a common result. Mutual understanding and trust between them are extremely important for the successful treatment and prevention of diseases. The doctor becomes not only an expert but also an adviser, and the patient becomes an active participant in his health. The doctor and the patient determine the treatment strategy, considering all aspects of the patient's health.

4.2 Key Requirement of 5P Medicine

The key requirements of 5P Medicine are the foundational elements that enable this modern approach to healthcare to function effectively. These requirements support a comprehensive and integrated system of healthcare that prioritises individual patient needs and outcomes. Here are the core requirements:

4.2.1. Personalized Healthcare Tools and Technologies

Genomic and Genetic Information: For personalisation to work, there must be access to genetic and molecular data to tailor treatments specifically for individual patients.

Advanced Diagnostics: The ability to conduct detailed tests and screenings (e.g., genetic sequencing, biomarkers) to understand a person's unique risk profile and health status.

Data Integration: Combining patient data from various sources (genetic, clinical history, lifestyle) holistically to develop personalised care plans.

4.2.2 Predictive Analytics and Risk Stratification

Predictive Models and Algorithms: Tools that use data (such as genetic, lifestyle, and medical history) to predict the likelihood of developing specific diseases or health conditions.

Big Data: The use of vast amounts of health data, often from electronic health records (EHRs), to identify patterns and predict health trends, helping prevent diseases before they manifest.

Artificial Intelligence (AI): AI-driven tools for early detection, risk assessment, and decision-making that support predictive medicine.

4.2.3. Preventive Healthcare Framework

Preventive Screening: Routine screenings for early disease detection and monitoring of risk factors, such as blood pressure checks, cancer screenings, and vaccination schedules.

Lifestyle Modification Programs: A framework for integrating behavioral changes (e.g., diet, exercise) to reduce the risk of chronic diseases, such as diabetes, hypertension, or heart disease.

Proactive Health Policies: Health guidelines and policies that promote preventive care, including education on healthy living and access to preventative services.

4.2.4. Patient Empowerment and Participatory Approach

Patient Education: Ensuring patients understand their health status, treatment options, and preventive measures so they can make informed decisions.

Patient Engagement: Involving patients in the decision-making process about their care, encouraging shared decision-making, and respecting their preferences and values.

Digital Health Platforms: The use of apps, wearable devices, and telemedicine to monitor health, track progress, and communicate with healthcare providers.

4.2.5. Collaborative and Partnering Healthcare System

Interdisciplinary Collaboration: The partnership between various healthcare providers (doctors, nurses, specialists, mental health professionals) to offer a comprehensive care plan.

Community Engagement: Collaboration with the broader community to ensure that healthcare is accessible, equitable, and culturally sensitive, particularly in underserved populations.

Patient-Provider Relationship: Developing a partnership between patients and healthcare providers, where the healthcare professional is a guide, mentor, and collaborator rather than just a decision-maker.

4.2.6. Access to Cutting-Edge Technologies

Digital Health Innovations: Utilizing telemedicine, AI-based diagnostic tools, wearable health devices, and mobile health applications to enhance patient care.

Tele-medicine and Remote Monitoring: Providing patients with access to healthcare professionals through digital platforms and allowing continuous health monitoring, especially for those with chronic conditions.

Electronic Health Records (EHR): Centralized digital records to track patient health over time, ensuring that personalized treatment plans are continuously updated and shared among healthcare providers.

4.2.7. Ethical and Legal Considerations

Data Privacy and Security: Safeguarding patient data, especially genetic and health information, in compliance with laws and ethical standards (e.g., HIPAA in the U.S.).

Equity in Access to Healthcare: Ensuring that all populations, regardless of socioeconomic status, have access to personalized, preventive, and predictive healthcare.

Informed Consent: Patients must be educated and provide informed consent, especially in areas involving genetic testing or personalized medicine.

4.2.8 In Summary:

The key requirements of 5P Medicine include a robust infrastructure for data collection, predictive analytics, preventive measures, patient empowerment, and collaboration between all stakeholders. These elements rely on modern technologies, patient-centred care, and interdisciplinary approaches to ensure that healthcare is reactive but also anticipatory, personalised, and inclusive. To implement this approach effectively, there needs to be strong integration between cutting-edge technologies, patient engagement strategies, and healthcare policies that promote accessibility and equity.

4.3 The Importance of 5P Medicine

The Importance of 5P Medicine lies in its ability to transform healthcare into a more efficient, proactive, and patient-centered system. By focusing on individualized care and utilizing advanced technologies, 5P medicine addresses some of the most pressing challenges in modern healthcare, such as rising healthcare costs, increasing disease burden, and the need for more effective treatment strategies. Below are the key reasons why 5P medicine is so important:

4.3.1 Improves Treatment Outcomes

- **Tailored Approaches**: Personalized medicine ensures that treatments are specifically designed to match the genetic profile, lifestyle, and needs of individual patients. This increases the likelihood of successful outcomes, especially for complex diseases like cancer, where personalized therapies (e.g., targeted therapies or immunotherapies) can be far more effective than one-size-fits-all treatments.
- **Precision Targeting**: By focusing on the underlying causes of diseases at the molecular level, 5P medicine can lead to more effective, less toxic treatments, thereby improving patients' overall quality of life.

4.3.2 Prevents Disease Before It Starts

- **Early Detection**: Predictive medicine allows for early identification of risk factors and diseases before symptoms appear. This enables early interventions that can prevent the development of chronic conditions (e.g., heart disease, diabetes) or manage them more effectively when they do arise.
- **Reducing Disease Burden**: Preventive measures, such as vaccinations, screening programs, and health monitoring, significantly reduce the prevalence of diseases in populations, leading to better public health outcomes and less strain on healthcare systems.

4.3.3 Reduces Healthcare Costs

- **Minimising Hospitalisations**: By focusing on preventive care and early detection, 5P medicine helps reduce the need for expensive emergency treatments, hospitalisations, and surgeries. Identifying and treating conditions early can lower the overall financial burden on patients and healthcare systems.
- **Efficient Resource Use**: Personalized care leads to more efficient use of healthcare resources. Instead of generalised treatments or ineffective therapies, resources are directed toward the most effective and appropriate interventions for each individual, leading to reduced waste in the healthcare system.

4.3.4. Enhances Patient Engagement and Satisfaction

- **Patient-Centered Care**: Participatory medicine emphasises the importance of patients actively participating in their healthcare decisions. This can lead to greater satisfaction with care and better adherence to treatment plans, as patients are more likely to engage with treatments they have helped to shape.
- **Empowerment**: When patients are educated about their health and involved in decision-making, they feel more empowered to take control of their own well-being. This sense of empowerment can lead to healthier behaviours, improved self-management, and better long-term health outcomes.

4.3.5 Encourages Collaborative Care

- **Holistic Approach**: The partnering aspect of 5P medicine emphasises collaboration not only between patients and providers but also among healthcare teams. Interdisciplinary collaboration ensures that all aspects of a patient's health—physical, mental, and social—are addressed comprehensively.

- **Community and Global Health**: 5P medicine encourages collaboration beyond the individual level, including partnerships between researchers, public health officials, and policymakers. This collaborative approach fosters the development of public health policies that promote wellness, equity, and access to healthcare for all.

4.3.6 Addresses the Rising Prevalence of Chronic Diseases

- **Chronic Disease Management**: With the increasing prevalence of chronic diseases like obesity, diabetes, and cardiovascular disease, 5P medicine provides a much-needed shift in focus. By identifying high-risk individuals and implementing personalised preventive strategies, it can help curb the rise of these conditions and manage them more effectively when they do occur.
- **Long-Term Health**: 5P medicine emphasises the need for ongoing monitoring and adaptation of health strategies, ensuring that individuals receive care that evolves with their changing needs over time.

4.3.7 Advances in Medical Research and Innovation

- **Precision Research**: Personalized and predictive approaches rely on large datasets and advanced analytics, driving new medical discoveries. Genomic research, for instance, plays a crucial role in identifying the genetic basis of diseases, leading to the development of targeted therapies and innovative treatment options.
- **Faster Clinical Trials**: By focusing on more targeted patient populations and personalised treatments, clinical trials can become more focused and efficient. This allows for faster development and approval of new drugs and therapies.

4.3.8 Supports Global Health and Equity

- **Global Health Solutions**: 5P medicine encourages a more equitable distribution of healthcare resources and interventions, helping to address health disparities globally. By focusing on preventive care and early intervention, it can reduce the burden of disease in low-resource settings, improving health outcomes for underserved populations.
- **Reducing Health Inequality**: The principles of personalised medicine and preventive care are particularly important in addressing health inequalities. Tailored healthcare can be provided to different demographic groups, ensuring that vulnerable populations receive the most appropriate care.

4.3.9 Adapts to the Evolution of Medicine

- **Integrating Cutting-Edge Technologies**: The rapid advancements in genomics, artificial intelligence (AI), machine learning, and digital health technologies make the 5P approach increasingly feasible and relevant. These technologies help clinicians make better, data-driven decisions and enable personalised care at scale.
- **Precision in Healthcare Delivery**: The shift toward personalised, predictive, and preventive medicine reflects a broader trend in healthcare towards more efficient, data-driven, and patient-centered care.

4.3.10 Conclusion

The importance of **5P medicine** lies in its ability to provide more effective, accessible, and equitable healthcare solutions. By focusing on personalised care, early prevention, and patient involvement, 5P medicine addresses both the immediate needs of individual patients and the broader challenges facing global health systems. As healthcare continues to evolve, the 5P approach offers a transformative framework that prioritises the health and well-being of individuals while also improving the efficiency and sustainability of healthcare systems worldwide.

5.0 Research Areas By Clusters

This section summarises selected structured research needs and priorities that have been identified by researchers within the SJCHAS that are likely to address societal challenges in a comprehensive manner. These clusters point out areas of relevance, priority, and multidisciplinary advantage for articulation of future 'targeted' purposes in investigation and innovation. The outcome of research from these clusters will enable the university and the country at large to play its rightful role.

5.1 Biomedical sciences (Human Anatomy, Medical Physiology, Medical Biochemistry)

5.1.1 Basic Research as a Basis for Clinical Research and Practice

Basic research forms the foundational knowledge upon which clinical research and clinical practice are built. While clinical research is focused on studying health conditions in humans and applying new knowledge to improve patient care, basic research is focused on understanding the fundamental biological, chemical, and physiological mechanisms that underlie health and disease. Without basic research, clinical advancements would lack the scientific basis needed to develop effective treatments, diagnostic tools, and preventive strategies.

(i) Understanding Disease Mechanisms

- Cellular and Molecular Insights**:** Basic research helps uncover the underlying biological mechanisms that cause diseases. For instance, studies in molecular biology, biochemistry, and genetics reveal how mutations in DNA or disruptions in cellular processes lead to conditions like cancer, cardiovascular disease, or neurodegenerative disorders.
- Pathogenesis and Etiology: By understanding the molecular causes of diseases, researchers can identify potential targets for therapeutic intervention. For example, basic research on the immune system has led to the development of immunotherapy treatments for cancers, and understanding the biology of Alzheimer's disease has paved the way for new diagnostic approaches and drug candidates.

(ii) Biomarker Identification and Diagnostic Tools

- Biomarker Discovery: Basic research in genomics, proteomics, and metabolomics is essential for identifying biomarkers that can be used for early diagnosis, prognosis, and monitoring of diseases. For example, the discovery of genetic mutations associated with cystic fibrosis in basic research led to genetic testing that allows for earlier and more accurate diagnosis of the disease.
- Non-invasive Diagnostic Tools**:** Advances in basic research have enabled the development of non-invasive diagnostic tools, such as liquid biopsies (detecting cancer-related mutations in blood samples) and advanced imaging techniques (e.g., MRI and PET scans). These tools are now widely used in clinical settings.

(iii) Clinical Trials and Translational Research

- From Bench to Bedside (Translational Research)**:** Translational research bridges the gap between basic science and clinical application. It involves taking discoveries made in the lab (bench) and testing them in clinical settings (bedside). Basic research identifies potential drug targets, and clinical research tests how well new treatments work in human patients.
- Preclinical Studies**:** Before clinical trials, new therapies must undergo preclinical testing in animal models. These preclinical studies, based on basic research, determine whether a new treatment is

safe and effective enough to move into human trials. For example, animal studies on insulin resistance and diabetes have led to the development of new therapies for type 2 diabetes.

(iv) *Improving Treatment Strategies*

- Personalised Medicine**:** Basic research, particularly in genomics, has paved the way for personalised medicine—treatments that are tailored to the genetic makeup of individual patients. For example, research into the genetic mutations that drive breast cancer (such as BRCA1/BRCA2) has led to personalised treatment plans involving targeted therapies, such as PARP inhibitors.
- Understanding Drug Resistance**:** Basic research on how bacteria or cancer cells develop resistance to treatments informs the development of new drugs or combination therapies. Research on drug-resistant tuberculosis, for example, has led to new drugs and treatment protocols.

(v) Ethical and Social Implications of Medical Advances

- Ethical Frameworks**:** Basic research also provides a framework for understanding the ethical, social, and legal implications of new medical technologies. For example, genetic research on CRISPR technology has led to discussions about its ethical use in human genetic modification.
- Informed Decision-Making: Understanding the basic mechanisms of disease and treatment allows clinicians to better inform patients about their health conditions and treatment options. This helps in making informed care decisions, particularly in the context of genetic counselling or end-of-life decisions.

5.1.2 Research Topics

i. Establishment of Anatomical museum.
ii. Cultural Influences on Anatomical Variations in Tanzanian Populations.
iii. Establishment of Histology and Histopathology Laboratory.
iv. The effect of yellow fever on microvascular activity and biochemical changes.
v. Establishing Integrated Multisystem Research Laboratory for rodent model.
vi. Establishing Laboratory of Electrophysiology.

5.1.3 Stakeholders

Scientists, students, researchers, health care workers, and teachers of high medical schools will be key players in this cluster.

5.1.4.Expected Outputs

Anatomical Museum, Histology and Histopathology Laboratory, Integrated Multisystem Research Laboratory for rodents model, Laboratory of Electrophysiology, Project reports, Dissertation reports, Scientific articles, Short courses.

5.1.5 Duration

Two years

5.2. Pathology (Pathology, Microbiology and Immunology, Parasitology and Entomology)

5.2.1 Evidence-based approach for Prevention and treatment of infectious diseases

An evidence-based approach to the prevention and treatment of infectious diseases is grounded in the systematic use of the best available scientific evidence, combined with clinical expertise and patient preferences, to inform decision-making in healthcare. This approach ensures that interventions—whether preventive or therapeutic—are grounded in proven effectiveness and safety. The evidence-based model emphasises the use of data derived from well-conducted scientific studies, including randomised controlled trials (RCTs), cohort studies, meta-analyses, and systematic reviews, as well as insights from epidemiology, public health research, and clinical experience.

Key Elements of an Evidence-Based Approach

(iv) High-Quality Evidence:

- The foundation of evidence-based practices lies in using high-quality evidence to guide prevention and treatment decisions. This includes:
  - Systematic Reviews and Meta-Analyses: These aggregate and analyse the results of multiple studies to provide a more robust and generalised understanding of the effectiveness of an intervention.
  - Randomised Controlled Trials (RCTs): RCTs are considered the gold standard for testing the efficacy of medical interventions. They randomly assign participants to different treatment groups to eliminate bias and provide reliable data on outcomes.
  - Cohort Studies and Case-Control Studies: These are used when RCTs are not feasible (e.g., for rare diseases or ethical concerns) and provide insights into risk factors and treatment effectiveness.

(v) Integration of Clinical Expertise:

- Healthcare providers must apply their clinical knowledge and experience when interpreting evidence. Not all evidence may apply to every patient or situation, so clinicians must use their judgment to apply it to specific cases.

(vi) Patient Preferences and Values:

- An evidence-based approach involves not only considering the scientific data but also considering the preferences, values, and individual circumstances of patients. For instance, a treatment plan for infectious disease must align with the patient's lifestyle, cultural beliefs, and any coexisting health conditions.

(vii) Continuous Updating of Knowledge:

- Infectious diseases and pathogens evolve rapidly, and new evidence can emerge quickly. The evidence-based approach encourages ongoing monitoring of new research findings, allowing healthcare providers to adapt practices as new information becomes available.

5.2.2 Research Topics

4) Molecular-based identification and strategies to limit the Antimicrobial Resistance (AMR) development in bacteria.

5) Magnitude, distribution and associated factors for malaria and soil-transmitted helminths co-infection.

5.2.3 Stakeholders

Key players for this cluster will include scientists, students, researchers, healthcare workers, teachers of high medical schools, and communities.

3.2.4 Expected Outputs

Textbook, guidelines, project report, dissertation report, Scientific articles, Short courses.

5.2.5 Duration

Two years

5.3 Community Medicine and Public Health

5.3.1 Management of Infectious Diseases as the Global Health Problem

Infectious diseases have long been a major driver of morbidity and mortality worldwide, contributing significantly to global health burdens. However, in recent years, the landscape of infectious diseases has changed due to several factors, including new pathogens, antimicrobial resistance (AMR), global interconnectedness, climate change, and the growing health disparities between nations. These factors collectively make managing infectious diseases a pressing global health problem that requires a multifaceted approach encompassing prevention, treatment, surveillance, and response strategies at local, national, and international levels.

Antimicrobial Resistance (AMR)

AMR is one of the most significant threats to the global health management of infectious diseases. The overuse and misuse of antibiotics and other antimicrobial agents have led to the development of resistant strains of bacteria, viruses, fungi, and parasites. This makes treating common infectious diseases increasingly difficult, leading to longer hospital stays, more intensive care, higher healthcare costs, and an increased risk of death.

- Challenges: Common infections that were once easily treatable (e.g., pneumonia, urinary tract infections, tuberculosis, and gonorrhoea) are now becoming resistant to standard treatments. The rise of superbugs (e.g., methicillin-resistant Staphylococcus aureus (MRSA), carbapenem-resistant Enterobacteriaceae (CRE)) threatens to undo decades of medical progress.
- Solutions: Addressing AMR requires better stewardship of existing antibiotics, investment in new antibiotic discovery, infection prevention measures, and robust global surveillance systems to monitor and track resistance patterns. Governments, international organizations, and the pharmaceutical industry must collaborate to combat AMR.

Tuberculosis (TB)

TB remains one of the world's most significant infectious diseases, posing a major threat to global health. Despite being preventable and treatable, TB continues to affect millions of people each year and is a leading cause of death from infectious diseases globally. According to the World

Health Organization (WHO), TB kills over 1.5 million people annually, making it a persistent global health challenge.
The persistence of TB as a global health problem is due to multiple factors, including the high burden of disease in low- and middle-income countries, the rise of multidrug-resistant TB (MDR-TB), and the complex socio-economic factors that contribute to its spread. TB disproportionately affects the most vulnerable populations, including those with weakened immune systems, those living in poverty, and marginalised communities.

5.3.2 Research Topics

1) Antibiotic Resistance as a Global Health Pandemic: Challenges and Strategies.
2) Nutrition effect on treatment outcome of tuberculosis patients in Tanzania.

5.3.3 Stakeholders

Key players for this cluster will include scientists, social scientists, communities, policymakers, students, researchers, health care workers and teachers of high medical schools, population.

5.3.4 Expected Outputs

Textbook, guidelines, project report, dissertation report, Scientific articles, Short courses.

5.3.5 Duration

Two years

5.4 Clinical Medicine (Internal Medicine, Pediatrics and Child Health, Clinical Pharmacology, Psychiatry and Mental Health)

5.4.1 Preventive Medicine

Preventive medicine is a branch of medicine that focuses on the prevention of diseases rather than the treatment of illnesses once they occur. The primary goal of preventive medicine is to improve the overall health of individuals and communities by reducing the risk of diseases and promoting healthy lifestyles. It emphasises the importance of health promotion, early detection, and the proactive management of risk factors to prevent disease and maintain wellness.

Preventive medicine can be applied on multiple levels: individual, community, and population-wide. It includes strategies such as immunisation, screenings, lifestyle interventions, environmental changes, and policy-making aimed at reducing health risks and enhancing quality of life. The field is critical to addressing the rising global health challenges such as non-communicable diseases (NCDs), infectious diseases, and public health emergencies.

Preventive medicine is generally divided into three categories:

(i) Primary Prevention

Primary prevention focuses on preventing the onset of disease by reducing risk factors and promoting behaviors that lead to better health outcomes. The aim is to prevent the disease before it even begins.

- Immunisation: Vaccination programs to protect against diseases such as measles, polio, and influenza.
- Health Education: Educating the population about healthy behaviours (e.g., proper nutrition, exercise, smoking cessation) and environmental factors contributing to health risks.
- Screening and Early Detection: Some primary prevention involves screening healthy individuals for conditions that have risk factors but are not yet symptomatic (e.g., blood pressure screening to prevent hypertension or cholesterol screening to prevent cardiovascular disease).
- Environmental and Social Interventions: Policies and interventions to reduce environmental hazards such as pollution or unsafe living conditions.

(ii). Secondary Prevention

Secondary prevention focuses on detecting diseases in their early stages before they cause significant harm. This enables timely treatment to reduce the severity and progression of the disease. The goal is to identify diseases early, especially before symptoms develop.

- Screening Programs: For early detection of diseases such as cancer, diabetes, hypertension, and HIV. Examples include mammograms for breast cancer, colonoscopy for colorectal cancer, and blood tests for cholesterol and blood sugar levels.
- Regular Check-ups: Encouraging individuals to undergo routine health check-ups (e.g., annual physicals) to monitor for risk factors and early signs of diseases.
- Risk Factor Management: For example, prescribing medications to lower blood pressure in individuals diagnosed with early-stage hypertension to prevent cardiovascular complications.

(iii). Tertiary Prevention

Tertiary prevention is focused on managing and mitigating the effects of established diseases to prevent further complications, improve quality of life, and reduce disability. This is often the final stage of prevention and involves managing long-term conditions to prevent them from worsening.

- Rehabilitation: Helping individuals recover or cope with the consequences of disease (e.g., physical therapy after a stroke, cardiac rehabilitation for heart disease patients).
- Chronic Disease Management: Providing ongoing care and monitoring for patients with chronic conditions (e.g., diabetes, hypertension) to prevent complications such as kidney failure or amputations.
- Palliative Care: Offering symptom relief and end-of-life care for those with serious illnesses to improve their quality of life.

5.4.2 Research Topics

6) Healthy lifestyle strategy as prevention of chronic non-communicable diseases.

7) Prevention of drug resistance.

8) Maintaining of physical and mental health of students and staff of medical colleges and health-saving environment development.

9) Telemedicine and Digital Health.

5.4.3 Stakeholders

Key players for this cluster will include scientists, communities, policymakers, students, researchers, health care workers and teachers of high medical schools, population.

5.4.4 Expected Outputs

Textbook, guidelines, project report, dissertation report, Scientific articles, Short courses, a system of telemedicine consultations, and mobile applications for patients with chronic non-communicable diseases.

5.4.5 Duration

Three years

5.5 Surgery (General Surgery, Otorhinolaryngology, Ophthalmology, Orthopedics, Traumatology and Neurosurgery, Anesthesia, Critical Care and Emergency Medicine, Obstetrics and Gynaecology, Diagnostic Imaging)

5.5.1 Gynecological and reproductive health of women

Modern research in gynaecological and reproductive health focuses on advancing the understanding, prevention, and treatment of conditions that affect women's reproductive systems, as well as improving maternal health and fertility. This research spans a broad range of scientific fields, from genetics and molecular biology to clinical interventions, technological innovations, and social determinants of health. Below are the key areas of interest:

(i). Reproductive Health and Fertility

- Infertility and Assisted Reproductive Technologies (ART): Infertility remains a significant concern for many women, and modern research focuses on enhancing assisted reproductive technologies such as in vitro fertilisation (IVF), egg freezing, and embryo cryopreservation. Innovations in preimplantation genetic testing (PGT) are also expanding, enabling the selection of healthy embryos, reducing the risk of genetic disorders, and improving IVF outcomes. Moreover, studies are exploring genetic screening to identify underlying causes of infertility and the development of novel therapies for unexplained infertility.
- Fertility Preservation: With increasing awareness of the impact of age on fertility, research in fertility preservation is advancing. Technologies like oocyte freezing, ovarian tissue cryopreservation, and stem cell therapies are being explored to allow women to preserve fertility for later life, especially in cases of cancer treatments or other medical interventions that may impair fertility.

- Polycystic Ovary Syndrome (PCOS): PCOS is a common endocrine disorder that can lead to infertility. Research is focused on understanding its genetic basis, hormonal dysregulation, and the impact of lifestyle factors (e.g., diet, exercise, weight management) on fertility in women with PCOS. New treatments aimed at regulating insulin sensitivity, managing hormonal imbalances, and improving ovulation are being developed.
- Endometriosis: Endometriosis, a condition in which tissue similar to the uterine lining grows outside the uterus, can cause infertility and significant pain. Research is focused on early detection methods, genetic predispositions, and biomarkers for diagnosis, as well as new treatments that target the root causes, such as immunotherapy and targeted hormonal therapies.

(ii). Maternal Health and Pregnancy

- Preterm Birth and Pregnancy Complications: Understanding the underlying causes of preterm birth, preeclampsia, and gestational diabetes is a major focus of modern research. Scientists are working to identify genetic, environmental, and microbiological risk factors contributing to these complications. Researchers are also investigating new diagnostic tools and preventive strategies, such as blood biomarkers for preeclampsia and vaccines for infections linked to premature birth.
- Gestational Diabetes and Hypertensive Disorders: Studies aim to understand better the causes of gestational diabetes, hypertension, and preeclampsia and develop more effective treatments. Research is investigating the role of gut microbiota, inflammation, and genetics in these conditions. Advances in screening methods and early interventions may reduce the incidence of pregnancy complications and improve maternal and fetal outcomes.
- Maternal Mental Health: The mental health of pregnant and postpartum women is an increasingly important research focus. Studies on postpartum depression, anxiety disorders, and trauma seek to identify risk factors, biomarkers, and effective treatments, including psychotherapy, medication, and mindfulness-based interventions.
- Placental Function and Pregnancy Outcomes: Researchers are exploring how the placenta influences pregnancy outcomes, including fetal growth and development. Studies are investigating placental vascular function, hormonal activity, and immune responses to better understand complications such as fetal growth restriction and preterm birth.

(iii). Gynecological Cancers

- Ovarian Cancer: Ovarian cancer remains one of the most lethal cancers in women. Research is focused on improving early detection through biomarkers (such as CA-125 and HE4), liquid biopsy techniques, and genetic screening. Research into the use of targeted therapies, immunotherapies, and personalized treatment plans is aiming to improve survival rates and reduce recurrence.
- Cervical Cancer: With the advent of the HPV vaccine, much of the focus in cervical cancer research is now on screening methods, such as Pap smears and HPV testing, and developing better vaccines or treatment strategies for HPV-related cancers. Research into immune checkpoint inhibitors and gene therapies is ongoing, aiming to boost the immune system's ability to fight cervical cancer.
- Endometrial Cancer: Endometrial cancer is the most common gynecological cancer, and research is focused on early detection through biomarkers and genetic testing, as well as

precision therapies based on the molecular characteristics of tumors. The role of obesity, insulin resistance, and hormonal therapies is also being studied.

(iv). Menstrual Health and Disorders

- Menstrual Irregularities and Disorders: Research is focused on the diagnosis and treatment of various menstrual disorders, including dysmenorrhea (painful periods), amenorrhea (absence of periods), and menorrhagia (heavy periods). Studies are exploring the role of endometrial ablation, hormonal treatments, and non-pharmacological therapies (e.g., acupuncture, physical therapy) to improve symptom management.
- Menopause: As women live longer, research into menopausal transition and its long-term effects on women's health is expanding. This includes studies on the use of hormone replacement therapy (HRT), non-hormonal treatments, and the effects of menopause on bone health, cardiovascular health, and mental health.

(v). New Technologies in Gynecology and Reproductive Health

- Artificial Intelligence (AI) and Machine Learning: AI is increasingly being integrated into gynecological practice for diagnosis, image analysis, and personalized treatment. AI algorithms are being developed to analyze ultrasound images, MRI scans, and Pap smear slides, improving accuracy and reducing human error. Machine learning is also being used to predict treatment outcomes and identify women at risk for certain reproductive health conditions.
- 3D Printing and Bioprinting: 3D printing is being used in gynecology for creating personalized models of female reproductive organs, aiding in surgical planning, and improving patient education. Bioprinting is being explored for creating artificial tissues for reconstructive surgery and organ regeneration, including for conditions like uterine transplantation.
- Telemedicine and Digital Health: Telemedicine is increasingly being used in the management of gynecological and reproductive health. From remote consultations for contraceptive counseling to fertility tracking apps and online screening programs, digital tools are improving access to care, especially for underserved populations. Research is investigating the effectiveness and acceptability of these tools in real-world settings.

(vi) Women's Sexual Health

- Sexual Dysfunction and Pain: Research on sexual health is investigating conditions such as vulvodynia, dyspareunia (painful intercourse), and sexual dysfunction in both pre- and post-menopausal women. Researchers are exploring the use of laser therapy, vaginal estrogen, psychosexual therapy, and regenerative medicine (such as stem cell therapy) to improve sexual health outcomes.
- Contraceptive Technologies: Research in contraceptive methods continues to innovate with the development of long-acting reversible contraceptives (LARCs), such as IUDs, implants, and subdermal devices, as well as new hormonal and non-hormonal methods. Studies are also exploring the role of male contraception and non-hormonal approaches to birth control for women, such as gene editing or nanotechnology.

(vii) Social and Environmental Determinants of Women's Health

- Impact of Environmental Toxins: Exposure to environmental toxins, including endocrine-disrupting chemicals (EDCs), has raised concerns about its impact on women's reproductive health, particularly in relation to fertility, pregnancy outcomes, and cancer risk. Research is investigating the impact of pollution, plastics, and pesticides on reproductive function and seeking ways to mitigate these risks.
- Social and Economic Factors: Modern research also explores the impact of socioeconomic status, access to healthcare, education, and cultural factors on reproductive health outcomes. Studies are focusing on improving equity in healthcare access, particularly in low-income and underserved communities, and understanding how health policy can better support women's reproductive rights.

5.5.2 Research Topics

4) Chemoresistance in gynecological cancers.

5) Preterm Birth and Pregnancy Complications.

6) Telemedicine and Digital Health.

5.5.3 Stakeholders

Key players for this cluster will include scientists, communities, policy makers, students, researchers, health care workers, teachers of high medical schools, population.

5.5.4 Expected Outputs

Textbook, guidelines, project report, dissertation report, Scientific articles, Short courses, system of telemedicine consultations, mobile application for pregnant women.

5.5.5 Duration

Three years

5.6 NMT (Nursing Department)

5.6.1 Diseases prevention and screening

Disease prevention and screening are fundamental pillars of public health that focus on reducing the incidence, severity, and complications of diseases by detecting them early or preventing them altogether. Effective prevention and screening strategies can save lives, reduce healthcare costs, and improve overall health outcomes. These strategies apply to infectious and non-infectious diseases, including chronic conditions, cancers, and mental health disorders.

Here's an overview of modern approaches to disease prevention and screening:

Vaccination: One of the most effective ways to prevent infectious diseases. Vaccines protect against illnesses like influenza, measles, hepatitis, human papillomavirus (HPV), and more recently, COVID-19. Ongoing research into new vaccines, such as those for cancer prevention (e.g., HPV vaccines to prevent cervical cancer) or universal flu vaccines, is expanding preventive measures.

Lifestyle Modifications: Encouraging healthy behaviours can prevent a variety of diseases:

Diet and Nutrition: Promoting a balanced diet rich in fruits, vegetables, whole grains, and lean proteins while reducing processed foods, sugars, and trans fats helps prevent cardiovascular diseases, diabetes, obesity, and certain cancers.

Physical Activity: Regular exercise reduces the risk of chronic diseases, including heart disease, stroke, diabetes, and some cancers.

Smoking Cessation: Tobacco use is a major cause of preventable diseases, including lung cancer, heart disease, and chronic respiratory diseases. Smoking cessation programs, along with public health campaigns, help reduce smoking rates.

Alcohol Reduction: Limiting alcohol intake is critical for preventing liver diseases, cancers (especially breast, liver, and colorectal cancers), and mental health issues.

Mental Health Support: Preventing mental health disorders by reducing stress, promoting good sleep hygiene, and providing access to psychological support can help mitigate the development of anxiety, depression, and substance abuse disorders.

Environmental Controls: Reducing exposure to environmental hazards can prevent diseases:

Pollution control: Limiting exposure to air, water, and soil pollution can help prevent respiratory diseases, cancers, and neurological conditions.

Workplace Safety: Proper safety measures in workplaces reduce the risk of accidents, occupational diseases (such as lung diseases from asbestos exposure), and injuries.

Screening and Early Detection: Screening involves testing individuals for diseases before they show symptoms. This allows for the early detection of conditions when they are easier to treat. Early detection can prevent or reduce disease severity and mortality.

5.6.2 Project Topics

1) Health education on non-communicable diseases (cardiovascular diseases, diabetes mellitus etc.).
2) Diabetes and high blood pressure screening and HIV testing.

5.6.3 Stakeholders

Key players in this cluster will include scientists, communities, policy makers, students, researchers, health care workers, teachers of high medical schools, and the population.

5.6.4 Expected Outputs

Guidelines, project reports, Scientific articles, Short courses, brochures and flyers for the population, mobile screening points.

5.6.5 Expected Duration

Two years

5.7 PST (Pharmacy Department)

5.7.1 Safety of medicinal treatment

The safety of medicinal treatment is a critical aspect of healthcare, ensuring that medications provide the intended therapeutic benefits without causing significant harm or adverse effects. This involves a multi-step process from drug development to post-market surveillance. The goal is to minimize risks, protect patients, and optimize therapeutic outcomes. Below are the key aspects involved in ensuring the safety of medicinal treatment:

(i). Preclinical Research and Clinical Trials

- Preclinical Studies: These are laboratory and animal studies that assess the drug's potential toxicity, dosage range, and pharmacokinetics (how the drug is absorbed, distributed, metabolised, and excreted in the body). Researchers also assess the drug's potential for mutagenicity (ability to cause genetic mutations), carcinogenicity (ability to cause cancer), and teratogenicity (ability to cause birth defects).
- Phase I Clinical Trials: These initial human trials involve a small group of healthy volunteers (usually fewer than 100). Phase I studies assess the drug's safety and pharmacokinetics and determine the maximum tolerated dose (MTD). The focus is on identifying any immediate adverse effects and determining the drug's safe dosage range.
- Phase II Clinical Trials: These trials involve a larger group of patients (up to several hundred) who have the condition the drug is meant to treat. They aim to assess the efficacy of the drug and safety in the target patient population. This phase helps identify potential side effects, the drug's optimal dose, and whether it provides a therapeutic benefit.
- Phase III Clinical Trials: This phase involves even larger groups of patients (several hundred to several thousand) and seeks to confirm the drug's efficacy, further monitor its safety, and compare it with existing treatments or a placebo. Phase III trials generate the bulk of data used for regulatory approval by agencies like the FDA (U.S. Food and Drug Administration) or EMA (European Medicines Agency).

(ii). Regulatory Approval

Once clinical trials demonstrate that a drug is effective and has an acceptable safety profile, it is submitted for approval by regulatory agencies. These agencies evaluate the overall benefit-risk ratio of the drug. They rely on a drug's benefit-risk analysis, which balances the benefits it provides to patients against the potential risks and side effects. If the benefits significantly outweigh the risks, the drug is approved for use; if not, it may be rejected or require further study.

(iii) Post-Market Surveillance (Phase IV)

Once a drug is approved and marketed, it enters the post-market surveillance phase (Phase IV). This stage monitors the long-term safety and effectiveness of the drug in the general population.

- Adverse Drug Reactions (ADRs): Health authorities closely monitor reports of adverse drug reactions (ADRs) and side effects after the drug is released. Pharmacovigilance is the science of detecting, assessing, understanding, and preventing adverse effects or any other drug-related problems. In many countries, healthcare providers, patients, and pharmaceutical companies are required to report adverse events through systems like the FDA Adverse Event Reporting System (FAERS) in the U.S. or EudraVigilance in Europe.

- Drug Safety Monitoring: Risk Management Plans (RMPs) are developed to monitor safety in the real-world population. Some drugs may require ongoing monitoring after approval, especially for those with rare but serious side effects. The safety data collected in Phase IV often lead to label changes, such as revised dosages, new warnings, contraindications, or even withdrawal of the drug from the market if new risks are identified.
- Black Box Warnings: If serious adverse reactions or potential risks are discovered after approval, regulatory agencies may require black box warnings (the most serious warning on a drug label) to inform healthcare providers and patients about the risks.

(iv) Risk Factors and Vulnerable Populations

Some patients may be at higher risk of experiencing adverse effects due to various factors, such as:

- Age: Due to age-related changes in metabolism, renal function, and comorbid conditions, elderly patients may be more susceptible to certain medications. Infants and children may also respond differently to medications than adults, requiring careful dosing adjustments.
- Preexisting Conditions: Patients with conditions like liver or kidney disease, cardiovascular disorders, or autoimmune diseases may have altered drug metabolism and excretion, increasing the risk of toxicity or interactions with other medications.
- Pregnancy and Lactation: Certain drugs may not be safe for pregnant or breastfeeding women, as they can affect fetal or infant development. For example, teratogenic drugs can cause birth defects, and drugs may pass into breast milk, affecting the infant.
- Genetics and Pharmacogenomics: Genetic differences in drug metabolism can influence how individuals respond to medications. For instance, genetic variations can affect the activity of enzymes that metabolize drugs, leading to differences in efficacy or risk of side effects. Pharmacogenomic testing helps personalize treatment plans based on a patient's genetic makeup, improving safety and efficacy.

5. Drug Interactions and Polypharmacy

- Drug Interactions: The safety of medicinal treatments can be compromised if a drug interacts with another medication, food, or substance, altering its effectiveness or causing harmful side effects. Drug-drug interactions can lead to reduced therapeutic effects or increased toxicity. For example, antibiotics can interact with anticoagulants, leading to bleeding complications.
- Polypharmacy: Older adults or individuals with chronic diseases often take multiple medications simultaneously. Polypharmacy increases the risk of drug interactions, overlapping side effects, and medication errors, which can compromise patient safety. Healthcare providers need to carefully monitor drug regimens and assess potential interactions.

(v) Risk Mitigation Strategies

- Patient Education: Informing patients about their medications—how to take them correctly, possible side effects, and when to seek medical help—helps reduce the risk of harm. Education also includes understanding drug adherence and ensuring that patients follow prescribed treatment regimens.
- Monitoring and Follow-up: Regular monitoring through lab tests, vital signs, or other assessments ensures that any adverse effects or complications from a medication are

detected early. This is especially important for medications with known risks or those requiring dose adjustments, such as anticoagulants or chemotherapy agents.

- Use of Technology: Advances in clinical decision support systems (CDSS) and electronic health records (EHR) help healthcare providers track patient histories, flag potential drug interactions, and ensure that prescribing decisions align with up-to-date safety guidelines. Mobile health applications can also remind patients to take medications and report any side effects promptly.

(vi). Ethical Considerations and Informed Consent

Ensuring the safety of medicinal treatments also involves ethical considerations. Informed consent is a key part of the process, ensuring that patients understand the potential benefits, risks, and alternatives before starting a treatment regimen. They should be made aware of any potential side effects and the likelihood of these occurring. Informed consent is particularly crucial in clinical trials, where participants are aware that the drug may not yet have established safety data.

5.7.2.Project Topics

4) Building ADRS reporting culture for patient safety.

5) LASA (look-alike/sound-alike) causes medication errors and it's a potential threat to patients.

5.7.3 Stakeholders

Key players for this cluster will include scientists, communities, policymakers, students, researchers, healthcare workers, teachers of high medical schools, pharmacists, population

5.7.4 Expected Outputs

Guidelines, project reports, Scientific articles, Short courses, brochures and flyers for the population.

5.7.5 Expected Duration

Two years