

ARTIFICIAL INTELLIGENCE AND INTERNET OF THINGS ENABLED BLOOD DELIVERY SYSTEM FOR LAST MILE ACCIDENT VICTIMS

INTRODUCTION

In the realm of healthcare, every moment will count, and the ability to swiftly and efficiently deliver life-saving resources will be paramount. Sierra Leone, like many nations, will face a dire need for innovative solutions to improve its healthcare landscape. Maternal and infant mortality rates will remain disturbingly high, largely due to the inaccessibility of critical medical resources, particularly in remote areas.

But amidst these challenges lies an opportunity for transformation – an opportunity driven by technology, innovation, and an unwavering commitment to saving lives. The blood delivery system project, sought through funding from the National Science and Technology Council's call for STI solutions, will be that opportunity personified.

Imagine a world where every drop of blood needed in a medical emergency reaches its destination with lightning speed. Picture a future where a network of drones, an intricate blood group database, and a cutting-edge car crash alert system work in perfect harmony, driven by an AI-driven platform, to ensure that no life is lost due to lack of access to blood.

This is not science fiction; this is the blood delivery system we envision. It's a revolutionary approach to addressing one of Sierra Leone's most pressing healthcare challenges – ensuring that blood, the essence of life, is available where and when it's needed most.

Through this project, we aim to bridge the gap between life and death by establishing a state-of-the-art blood bank, integrating innovative technologies, and revolutionizing the way we respond to medical emergencies. Our vision is to save lives, and this project is our vehicle to turn that vision into reality.

The maximum funding amount of \$40,000 per project, with an 18-month timeline, exemplifies our determination to make a significant impact on Sierra Leone's healthcare landscape. In the pages that follow, we will outline the intricacies of our proposal, delving into the technical aspects, budget allocations, and expected outcomes. Join us on this journey to transform healthcare in Sierra Leone and to ensure that every citizen, regardless of where they are, has access to the vital resource of blood when they need it most.

ABSTRACT

In Sierra Leone, the state of healthcare, particularly concerning emergency response and blood transfusions for accident victims, has been fraught with challenges. High rates of preventable deaths have persisted due to inadequate access to safe and timely blood transfusions. The "Blood Delivery System for Last-Mile Accident Victims" project emerges as a beacon of hope in addressing these critical issues.

This project, drawing inspiration from the transformational power of technology, presents an innovative approach to saving lives during emergencies. Central to this system is the establishment of a state-of-the-art blood bank, equipped with advanced medical equipment and staff training, ensuring the safety and quality of stored blood.

Furthermore, the project focuses on creating a comprehensive national blood group database that links each patient's National Identification number with their blood type. This integration significantly enhances the efficiency of blood matching, reducing the risk of transfusion-related complications. The incorporation of drones for blood delivery to accident scenes and healthcare facilities in remote areas revolutionises the concept of timely access to blood, especially in life-threatening situations.

Notably, the project integrates an automotive car crash alert system, which automatically detects accidents and dispatches blood supplies with precision. GPS integration ensures accurate and timely delivery. A user-friendly mobile application for blood requests and real-time tracking further enhances emergency response.

Crucially, this project aims to impact the most vulnerable populations in Sierra Leone. It extends its reach beyond urban areas, ensuring that the most remote and underserved communities have access to life-saving blood transfusions. This commitment to inclusivity is exemplified through the incorporation of the "Automated Blood Delivery System" making the system accessible even in secluded villages.

Moreover, the project's dedication to open data and innovation extends to offering a publicly accessible API for its Local Language translation system and sharing insights into emergency response patterns with stakeholders and researchers. This approach empowers data-driven decision-making, transforming the healthcare landscape.

The "Blood Delivery System for Last-Mile Accident Victims" project leverages technology to create a more responsive and efficient healthcare system. It addresses the pressing issue of preventable deaths during emergencies and ushers in a new era of timely and accessible blood transfusions. By offering a comprehensive solution, it brings hope to Sierra Leone, transforming emergency healthcare access and saving countless lives, particularly in the most remote and underserved areas.

SCIENTIFIC BACKGROUND

The integration of Artificial Intelligence (AI) into healthcare and emergency response systems is a rapidly evolving field with significant potential to enhance the effectiveness of emergency healthcare services. Recent years have witnessed extensive research and application of AI in healthcare, illuminating how this transformative technology can revolutionise emergency healthcare services. This scientific background integrates key research and developments in AI within healthcare and correlates them with the "Blood Delivery System for Last-Mile Accident Victims" project.

1. AI in Healthcare and Emergency Response:

The incorporation of AI into healthcare has been the subject of extensive research and practical applications, particularly in the context of emergency healthcare services. Researchers and industry leaders have recognized the immense potential of AI to address pressing issues in healthcare. This potential is exemplified by the contributions of leading institutions and biomedical companies, which have made substantial strides in this field.

MedARC: MedARC, a renowned healthcare technology company, has been at the forefront of AI-driven innovations in healthcare. The company is actively leveraging AI to analyse patient data, optimise treatment plans, and enhance the efficiency of healthcare delivery. MedARC's AI systems have demonstrated their ability to streamline clinical processes and improve patient outcomes. This research and practical application of AI within healthcare, notably in the context of patient data analysis and real-time treatment adjustments, aligns closely with the goals of the "Blood Delivery System for Last-Mile Accident Victims" project.

Biomedical Company Utilising AI: Various leading biomedical companies have embraced AI to revolutionise healthcare. By utilising AI-driven diagnostics, predictive analytics, and treatment recommendations, these companies have significantly improved patient care and healthcare infrastructure. Their work has not only enhanced the efficiency of healthcare delivery but also the quality of medical services. The AI-driven approaches employed by these companies are directly applicable to emergency healthcare and blood delivery systems.

2. AI in Healthcare and the National Development Plan:

The application of AI in healthcare significantly aligns with Sierra Leone's National Development Plan (NDP), particularly cluster one, emphasising Human Capital Development. AI has the potential to enhance healthcare infrastructure, improve medical services, and save lives. It fosters human capital development by augmenting healthcare quality and access. Additionally, AI contributes to cluster three of the NDP, Infrastructure and Economic Competitiveness, by emphasising the importance of information and communications technology (ICT), digital transformation, and AI components within healthcare. The project's indirect impact extends to clusters five, six, and eight, addressing various sectors and fostering cross-cutting development. Importantly, the project's inclusive approach strives to bridge the digital divide in Sierra Leone by ensuring access for the 72% of the population without internet connectivity.

3. Key Areas of Impact:

To grasp the full potential of AI in healthcare and emergency response, it is essential to delve into specific domains:

AI-Driven Personalized Treatment: Personalised treatment, enhanced by AI, has gained prominence in contemporary healthcare research. AI's ability to analyse patient data and recommend tailored treatment plans has significantly improved patient outcomes. In the context of the "Blood Delivery System for Last-Mile Accident Victims," AI can be employed to

ensure the efficient allocation of blood resources, facilitating timely delivery and minimising wastage.

Early Intervention Systems: AI's predictive capabilities are invaluable in anticipating critical health conditions. By analysing patient data and identifying individuals at risk, AI tools enable timely interventions, which can significantly improve patient outcomes. The research by Xie et al. in 2018 underscores the importance of early intervention, a concept directly applicable to emergency healthcare.

Open Data in Healthcare: The trend towards open data and transparency in healthcare mirrors the broader movement of fostering a culture of collaboration and innovation. Open data promotes knowledge sharing, data-driven decision-making, and the advancement of healthcare services, aligning with the goals of the "Blood Delivery System for Last-Mile Accident Victims."

Incorporating these AI-driven insights and innovations into the "Blood Delivery System for Last-Mile Accident Victims" project has the potential to significantly transform emergency healthcare delivery, reduce preventable fatalities, and create a more efficient and responsive system. This alignment with global trends and research in AI application within healthcare and emergency response systems underscores the project's potential to save lives and advance healthcare in Sierra Leone.

Advantages of the Proposed Blood Delivery System

The proposed "Blood Delivery System for Last-Mile Accident Victims" project offers several advantages for Sierra Leone's emergency healthcare landscape, providing innovative solutions to critical challenges.

1. Timely Access to Life-Saving Blood:

The project addresses one of Sierra Leone's most pressing issues by ensuring timely access to life-saving blood for accident victims. This advantage is paramount in

reducing preventable fatalities, especially in emergencies where swift access to compatible blood can make the difference between life and death.

2. Advanced Blood Bank Infrastructure:

By establishing a state-of-the-art blood bank, equipped with modern medical equipment, the project ensures the safety and quality of stored blood. This infrastructure not only enhances the overall healthcare system but also promotes efficient blood collection, storage, and distribution.

3. National Blood Group Database:

The integration of a comprehensive national blood group database linked to patients' National Identification numbers ensures precise blood matching. This advancement minimises the risk of transfusion-related complications and guarantees a higher standard of care for patients.

4. Drone-Based Blood Delivery:

The utilisation of drones for blood delivery to remote and accident-prone areas revolutionises emergency healthcare. This approach facilitates rapid and precise blood supply to even the most challenging locations, thereby saving lives.

5. Automotive Car Crash Alert System:

The project integrates an automotive car crash alert system that automatically detects accidents and dispatches blood supplies with precision. This feature significantly reduces response times and ensures that blood arrives at accident sites promptly.

6. User-Friendly Mobile Application:

The development of a user-friendly mobile application for blood requests and real-time tracking enhances emergency response. This intuitive tool empowers both healthcare professionals and accident victims to request and track blood deliveries efficiently.

7. Inclusivity Beyond Internet Access:

The incorporation of the "Blood Delivery System" in the project ensures that the system is fully accessible, even in the most remote and internet-deprived areas. This commitment to inclusivity makes sure that no one is left behind, regardless of their location or connectivity.

8. Commitment to Open Data and Collaboration:

The project's dedication to open data, as manifested through a public API and shared insights, aligns with the global trend of collaborative research and data sharing. This initiative positions Sierra Leone at the forefront of optimising AI-driven solutions in emergency healthcare.

9. Enhanced Emergency Response:

The system's integration of AI and advanced technologies significantly enhances emergency response capabilities. By facilitating the swift delivery of blood to accident

sites and healthcare facilities, it contributes to reducing fatalities and improving the overall quality of emergency healthcare services.

10. Potential to Save Lives:

Perhaps the most significant advantage of this project is its potential to save lives. By addressing the critical issue of timely access to blood during emergencies, it stands to reduce preventable deaths, making Sierra Leone's healthcare system more robust and responsive to the needs of its population.

In summary, the "Blood Delivery System for Last-Mile Accident Victims" project offers a holistic solution to critical challenges in Sierra Leone's emergency healthcare landscape. Its multifaceted approach, incorporating advanced technologies and a commitment to inclusivity and collaboration, positions it as a transformative initiative that has the potential to save lives and significantly enhance the well-being of the population.

3. GOALS AND SPECIFIC OBJECTIVES

Overall Goal:

The overarching goal of the "Blood Delivery System for Last-Mile Accident Victims" project is to leverage cutting-edge technology and innovation to revolutionise emergency healthcare services in Sierra Leone. The project aims to save lives by ensuring timely and efficient access to life-saving blood, especially in remote and underserved areas.

Research Objectives:

1. Assessment of Critical Healthcare Challenges:

- Understand and quantify the specific challenges in Sierra Leone's emergency healthcare system, particularly in terms of blood supply, access, and delivery. This objective seeks to provide a comprehensive overview of the existing gaps and limitations in the current healthcare infrastructure.

2. Establishment of Advanced Blood Bank Infrastructure:

- Design, develop, and implement a state-of-the-art blood bank infrastructure equipped with modern medical equipment. The objective is to create a safe and efficient system for collecting, storing, and distributing blood.

3. Creation of a National Blood Group Database:

- Develop a comprehensive national blood group database that links patients' National Identification numbers with their blood type information. This objective aims to enhance the precision and speed of blood matching, reducing the risk of transfusion-related complications.

4. Drone-Based Blood Delivery System:

- Explore and implement drone technology for the rapid and precise delivery of blood to accident scenes and healthcare facilities, particularly in remote areas. The objective is to significantly reduce response times and save lives during emergencies.

5. Integration of Automotive Car Crash Alert System:

- Incorporate an automotive car crash alert system that automatically detects accidents and triggers the rapid dispatch of blood supplies. This objective focuses on improving the accuracy and speed of emergency responses.

6. User-Friendly Mobile Application:

- Develop a user-friendly mobile application that allows healthcare professionals and accident victims to request blood deliveries and track their progress in real-time. The objective is to enhance the efficiency of emergency response and communication.

7. Inclusivity and Accessibility Beyond Internet:

- Implement the "Automated Blood Delivery System" to ensure that the blood delivery system is fully accessible in even the most remote and internet-deprived areas. This objective is aligned with the project's commitment to inclusivity and ensuring that all regions have access to life-saving blood.

8. Commitment to Open Data and Collaboration:

- Demonstrate a dedication to open data by offering a public API and sharing insights into emergency response patterns with stakeholders and researchers. This objective aligns with the global trend of collaborative healthcare research and data-driven decision-making.

9. Enhanced Emergency Response:

- Implement advanced technologies and AI-driven solutions to enhance emergency response capabilities. The objective is to improve the quality of emergency healthcare services, reduce fatalities, and save lives during critical situations.

10. Impact on Preventable Deaths:

- The ultimate objective of the project is to have a direct impact on reducing preventable deaths during accidents and emergencies. By addressing critical challenges in the healthcare system, the project aims to make a substantial contribution to the well-being and safety of Sierra Leone's population.

In summary, the "Blood Delivery System for Last-Mile Accident Victims" project has a comprehensive set of research objectives aimed at transforming the emergency healthcare landscape in Sierra Leone. The project seeks to save lives, enhance healthcare infrastructure, and improve the quality of healthcare services through innovative technology and a commitment to inclusivity and collaboration.

Significance, Importance, and Innovation of the "Blood Delivery System for Last-Mile Accident Victims" Project

Sierra Leone faces critical challenges in its healthcare system, particularly in emergency response and access to life-saving blood. The significance and importance of the "Blood Delivery System for Last-Mile Accident Victims" project extend beyond healthcare; it is a matter of saving lives, improving healthcare infrastructure, and bridging crucial social, economic, and geographical divides.

1. Revolutionary Blood Delivery System:

The project introduces an innovative blood delivery system that has the potential to revolutionise emergency healthcare in Sierra Leone. By leveraging advanced technologies such as drones, AI, and a comprehensive blood bank infrastructure, the project aims to set a new standard in emergency response and blood supply management.

2. Advanced Blood Bank Infrastructure:

The establishment of a state-of-the-art blood bank ensures the safety and quality of stored blood. This innovation not only improves blood collection and storage but also sets a benchmark for healthcare infrastructure in Sierra Leone.

3. Precise Blood Matching with National Database:

The creation of a national blood group database, linked to patients' National Identification numbers, ensures precise blood matching. This feature significantly reduces the risk of transfusion-related complications, emphasising the importance of patient safety and healthcare quality.

4. Timely and Automated Emergency Response:

The integration of an automotive car crash alert system, coupled with drone-based blood delivery, offers a pioneering approach to emergency response. This automation ensures that blood is delivered with unprecedented speed and accuracy during critical situations.

5. Inclusivity Beyond Internet Access:

The project's commitment to inclusivity is exemplified through the incorporation of the "Last mile blood delivery system". This innovation ensures that the blood delivery system is accessible even in remote and internet-deprived areas, extending its reach to underserved communities.

6. Commitment to Open Data and Collaboration:

The project's dedication to open data, represented by a public API and shared insights into emergency response patterns, aligns with the global push for collaborative healthcare research. This commitment transforms the project into a valuable data source for healthcare stakeholders and researchers.

7. Direct Impact on Preventable Deaths:

The project's significance lies in its potential to directly impact the reduction of preventable deaths during accidents and emergencies. By addressing critical challenges in the healthcare system, it aims to save lives and enhance the overall well-being of Sierra Leone's population.

In summary, the "Blood Delivery System for Last-Mile Accident Victims" project is a transformative initiative that brings innovation to the forefront of Sierra Leone's emergency healthcare landscape. It has the potential to save lives, improve healthcare infrastructure, and bridge vital divides in access to life-saving blood. The project's multifaceted approach and dedication to inclusivity and collaboration position it as a pioneering solution with profound significance and importance for the country.

Potential Benefits of the "Blood Delivery System for Last-Mile Accident Victims" Project:

1. Timely and Life-Saving Blood Access:

- The project ensures that accident victims, regardless of their location, have timely access to life-saving blood. This benefit directly translates to a higher chance of survival and reduced fatalities in emergency situations.

2. Improved Healthcare Infrastructure:

- The establishment of a state-of-the-art blood bank and advanced medical equipment enhances the overall healthcare infrastructure in Sierra Leone. This improvement extends beyond emergency situations, benefiting the entire healthcare system.

3. Enhanced Patient Safety:

- By creating a national blood group database and implementing precise blood matching, the project significantly reduces the risk of transfusion-related complications. This safety enhancement ensures that patients receive the correct blood type, minimising adverse reactions.

4. Swift Emergency Response:

- The integration of an automotive car crash alert system and drone-based blood delivery ensures rapid and accurate emergency responses. This benefit directly impacts accident victims by reducing response times and providing timely medical care.

5. Efficiency in Healthcare Services:

- The user-friendly mobile application for blood requests and real-time tracking improves communication and efficiency within the healthcare system. Healthcare professionals can quickly and accurately request blood supplies, further improving patient care.

6. Inclusivity Beyond Internet Access:

- The project's commitment to accessibility, even in remote areas without internet access, ensures that all regions of Sierra Leone have equal access to life-saving blood. This inclusivity is a crucial benefit, especially for underserved communities.

7. Data-Driven Decision-Making:

- The commitment to open data and the provision of a public API for healthcare data enables stakeholders and researchers to make data-driven decisions. This

benefit enhances the overall quality of healthcare services and facilitates continuous improvement.

8. Reduced Preventable Deaths:

- The ultimate benefit of the project is its potential to reduce preventable deaths. By ensuring that life-saving blood is readily available in critical situations, the project directly contributes to saving lives and improving the well-being of Sierra Leone's population.

In summary, the "Blood Delivery System for Last-Mile Accident Victims" project offers a range of potential benefits that significantly impact emergency healthcare services in Sierra Leone. From swift emergency responses to enhanced patient safety and inclusivity, the project is poised to revolutionise emergency healthcare and save lives.

4. PROJECT METHODOLOGY/ APPROACH - Blood Delivery System for Last-Mile Accident Victims

Conceptual and Theoretical Framework:

This research project operates within the framework of a transformative approach to emergency healthcare, recognizing the systemic nature of healthcare delivery. It addresses the critical issue of blood supply, positioning the blood delivery system as a transformative agent. The approach examines the interconnectedness of technology, infrastructure, and healthcare dynamics in Sierra Leone, with a focus on revolutionising emergency response and access to life-saving blood.

User Participation:

Involving the end-users of the system, including healthcare professionals and accident victims, is integral to the project's success. Their insights and needs have been considered from the project's inception, ensuring the alignment of the blood delivery system with real-world requirements. Continuous engagement will be fostered through consultation, feedback collection, and user testing throughout the project's development and implementation.

Software Development Methodology:

Developing the software components of the blood delivery system follows an agile approach due to the need for continuous refinement and adaptation. The Agile methodology is suitable for short development cycles (sprints) with deliverables at the end of each cycle. This approach enables rapid development, testing, and adaptation to user feedback.

Data Collection for Software Development:

- 1. User Requirements:** Gather user requirements by engaging healthcare professionals and emergency responders to understand their specific needs and expectations for the system's functionality.
- 2. Feedback Loops:** After each development sprint or prototype testing, collect feedback from end-users, including healthcare professionals, accident victims, and system administrators. This feedback will inform subsequent development iterations.

AI Model Development:

The blood delivery system incorporates AI-driven components, such as predictive analytics for accident detection and drone navigation. These AI models are essential for the system's functionality and will be developed using extensive data collection and model training.

Data Collection for AI Model Development:

- 1. Data Preparation:** Gather and preprocess data from various sources, including accident data, GPS coordinates, and blood supply data, to prepare it for AI model training.
- 2. Model Building:** Develop and train AI models using the prepared data, including machine learning algorithms for accident prediction and drone flight path optimization.
- 3. Feedback Collection:** Continuously collect feedback on the accuracy and performance of AI models in real-world scenarios to refine and improve their predictions.

Data Analysis:

- 1. Quantitative Analysis:** Utilise advanced statistical tools and libraries, such as Python's pandas and Matplotlib, to analyse quantitative data related to accident prediction accuracy, drone flight path optimization, and system performance.
- 2. Qualitative Analysis:** Analyse qualitative data collected from user feedback, system administrators, and accident victims to gain insights into user experiences and areas of improvement.
- 3. Data Security & Storage:** Ensure that all data, especially sensitive medical and location data, is securely stored with encryption for both in transit and at rest. Access to the data will be limited to authorised personnel, and robust security protocols will be employed for data integrity and confidentiality.
- 4. Data Sharing & Archiving:** The project's commitment to data-driven decision-making will be upheld by providing anonymized and non-sensitive datasets for researchers and stakeholders upon request. Data will be archived using secure platforms to ensure long-term preservation.

In summary, the project's methodology combines a transformative approach to emergency healthcare with agile software development and AI model training. It emphasises continuous user engagement and feedback collection to ensure that the blood delivery system effectively meets the needs of healthcare professionals and accident victims while enhancing emergency response capabilities. Data-driven decision-making and data security are integral components of the project's approach.

5. ANTICIPATED OUTPUTS AND OUTCOMES - Blood Delivery System for Last-Mile Accident Victims

Anticipated Outputs:

1. Research Publications: Research papers and publications focusing on the development and implementation of the blood delivery system, emphasising the integration of advanced technologies in emergency healthcare.

2. Policy Recommendations: Comprehensive policy briefs summarising key insights and recommendations for policymakers. These documents will provide a roadmap for optimising emergency response and blood supply management in Sierra Leone.

3. Technological Platforms: The fully developed and operational blood delivery system, designed to address Sierra Leone's unique needs in emergency healthcare.

4. Data and Model Protocols: Detailed documentation outlining the data collection, model training, and deployment protocols employed during the development and implementation of the AI-driven components of the blood delivery system.

Anticipated Outcomes:

1. Enhanced Emergency Response: The adoption of the blood delivery system is expected to significantly enhance emergency response capabilities, leading to faster and more efficient blood supply in life-threatening situations.

2. Improved Patient Outcomes: With a more reliable and timely supply of blood, it is anticipated that patient outcomes will improve, with reduced morbidity and mortality rates among accident victims.

3. Policy Impact: The successful implementation of the blood delivery system may influence national healthcare policies, paving the way for tech-driven healthcare solutions and more efficient emergency response strategies.

4. Strengthened Healthcare Collaborations: The project is expected to foster collaborations between healthcare professionals, technology providers, and government stakeholders, promoting a coordinated approach to healthcare innovation and implementation.

5. Community Engagement: Increased community involvement and awareness in emergency healthcare, with a focus on the importance of blood donation and emergency response.

6. Regional Influence: The success of the project could serve as a model for neighbouring countries, potentially influencing regional healthcare policies and strategies.

Engagement Strategies:

1. Stakeholder Workshops: Regular workshops involving healthcare professionals, policymakers, and technology providers to discuss project progress, gather feedback, and ensure alignment with healthcare needs.

2. Community Awareness Campaigns: Educational campaigns targeted at communities, emphasising the importance of blood donation and awareness of the new emergency response system.

3. Policy Brief Sessions: Sessions dedicated to presenting policy briefs and recommendations to policymakers, guiding informed decision-making and policy development in the healthcare sector.

4. Student Education: Educational workshops and awareness programs for students to promote a culture of blood donation and safe practices in the event of accidents.

5. Public Awareness: Widespread public awareness campaigns to inform the general population about the benefits of the blood delivery system and its potential impact on saving lives in emergencies.

In summary, the anticipated outputs and outcomes of the blood delivery system project are comprehensive and multifaceted. They encompass research publications, policy recommendations, the development of technological platforms, and clear documentation of protocols. The expected outcomes include improved emergency response, policy impact, strengthened collaborations, community engagement, and potential regional influence. Various engagement strategies will be employed to ensure that the project's outputs and outcomes are effectively communicated and implemented.

6. KNOWLEDGE UTILISATION AND DISSEMINATION PLAN - Blood Delivery System for Last-Mile Accident Victims

Dissemination of Findings:

The research findings and outcomes of the blood delivery system project will be disseminated through a multi-pronged approach to ensure broad visibility and impact. Key dissemination methods include:

1. Policy Briefs: Succinct policy briefs will be created, summarising the project's objectives, outcomes, and recommendations. These will be distributed to relevant government agencies, healthcare institutions, and other stakeholders.

2. Workshops and Seminars: Targeted workshops and seminars will be conducted to engage with healthcare professionals, policymakers, and educators. These sessions will provide a platform for in-depth discussions and collaborative dialogue on how the blood delivery system can influence healthcare policies and practices.

3. Digital Platforms: Findings will be made available on digital platforms, including a dedicated project website. Information on the project's progress, research papers, and relevant documentation will be accessible to a wide online audience.

Target Audience/Beneficiaries:

The primary beneficiaries of the project include:

- **Patients:** Accident victims and individuals in need of emergency blood transfusions will directly benefit from improved access to timely blood supply.
- **Healthcare Professionals:** Doctors, nurses, and healthcare staff will benefit from enhanced emergency response capabilities and improved patient outcomes.
- **Policymakers:** Government agencies and policymakers will gain insights into the potential impact of tech-driven healthcare solutions and efficient emergency response strategies.

Influencing Policy and Practice:

To influence policy and practice, the project will engage with relevant stakeholders in healthcare and education, including policymakers and educators. The following approaches will be employed:

- **Dedicated Policy Sessions:** Organising sessions and workshops specifically aimed at policymakers and educators to facilitate dialogue and collaboration in moulding healthcare and emergency response policies based on research insights.
- **Collaborative Decision-Making:** Facilitating discussions and decision-making processes that involve stakeholders from the healthcare and education sectors. Collaborative engagement will be a cornerstone of influencing policy and practice.

Media Engagement Plans:

Media engagement is crucial to create awareness, promote the blood delivery system, and gain valuable feedback during the iterative building process. The project will employ the following media engagement strategies:

- **Social Media Campaigns:** Active use of social media campaigns to rapidly disseminate information about the project, its objectives, and its impact on emergency healthcare. Social media platforms will serve as a conduit for public engagement and feedback.
- **Traditional Media:** Engaging with traditional media outlets, including television, radio, and newspapers, to reach a wider audience and educate the public about the significance of the blood delivery system.

Open Access Policy:

The project strongly advocates for an open access policy, ensuring that research findings, data, and insights are readily accessible to a broader audience. This commitment to open access aligns with principles of transparency, collaboration, and data-driven decision-making. The project supports open data and innovation to benefit students in higher institutions of learning and the wider community.

In summary, the knowledge utilisation and dissemination plan for the blood delivery system project emphasises a multi-faceted approach, including policy briefs, workshops, digital

platforms, targeted engagement with key stakeholders, media outreach, and a commitment to open access. These strategies aim to ensure that the project's findings are effectively disseminated and utilised to influence policy and practice in emergency healthcare in Sierra Leone.

Rationale for Dissemination Approach - Blood Delivery System for Last-Mile Accident Victims

The chosen multifaceted dissemination approach is grounded in the need to reach a wide range of stakeholders, ensuring that the project's findings and outcomes resonate with various audiences. The following rationales support this approach:

1. Engaging Stakeholders: The blood delivery system project involves a diverse set of stakeholders, ranging from healthcare professionals and policymakers to educators and the general public. Each group plays a unique role in the success and impact of the project. Therefore, a multifaceted approach is crucial to engage all relevant parties effectively.

2. Relevance and Impact: Tailoring communication to specific audiences guarantees the relevance and impact of the project's findings. Policymakers need concise policy briefs, while healthcare professionals may require in-depth seminars. This approach ensures that each stakeholder group receives information in a format that aligns with their needs and interests.

3. Collaborative Decision-Making: Healthcare and education policies, as well as emergency response strategies, are highly influenced by the input and collaboration of multiple stakeholders. Engaging stakeholders through various channels encourages collaborative decision-making, fostering a sense of ownership and commitment to the project's success.

4. Public Awareness: The general public, particularly those residing in remote areas, is a vital part of the project's success. By employing a multifaceted approach that includes media engagement and digital platforms, the project can effectively raise public awareness and gain valuable feedback from individuals who may directly benefit from the blood delivery system.

5. Transparency and Accessibility: Embracing diverse communication channels aligns with principles of transparency and accessibility. The open access policy ensures that project findings are readily available to all, promoting transparency and collaboration within the community and beyond.

In summary, the rationale for the chosen multifaceted dissemination approach stems from the diverse stakeholder landscape involved in the project. Tailoring communication to specific audiences ensures relevance and impact, promotes collaborative decision-making, raises public awareness, and upholds principles of transparency and accessibility. This approach is designed to maximise the project's reach and influence in Sierra Leone's healthcare landscape.

7. PROJECT GOVERNANCE - Blood Delivery System for Last-Mile Accident Victims

Governance Structure:

The project will implement a robust governance structure to ensure effective oversight, alignment with project objectives, and adherence to project timelines. The governance structure comprises the following components:

1. Steering Committee: A steering committee will be established to provide overarching governance and strategic direction for the project. The committee will be responsible for decision-making, risk assessment, and ensuring that project goals are met. It will include key project stakeholders, project leads, and representatives from relevant institutions.

Advisors Incorporation:

The project will benefit from the expertise and guidance of a panel of advisors who will provide strategic oversight and contribute their knowledge and insights. The panel of advisors will consist of the following categories:

1. Academic Experts: Leading academic experts in fields relevant to the project, such as healthcare, emergency response, and artificial intelligence, will provide academic guidance and research insights.

2. Industry Professionals: Experienced professionals from the healthcare and technology sectors will offer practical industry insights, ensuring the project remains aligned with real-world needs and trends.

3. Policy Advocates: Policy advocates and experts in healthcare policy and innovation will contribute their knowledge to ensure that the project's outcomes align with national and international policy goals.

Research Team Composition:

The research team will be composed of a diverse group of experts and professionals with expertise in various areas essential to the success of the blood delivery system project. The team composition will encompass the following roles and responsibilities:

1. Project Leads: Experienced project managers and leaders will oversee the day-to-day activities, ensuring project milestones are achieved and objectives are met.

2. Healthcare Professionals: Medical experts and healthcare practitioners will contribute their knowledge to ensure that the blood delivery system meets the highest healthcare standards.

3. Technology Specialists: Technology experts, including AI and software developers, will lead the development and implementation of the technical aspects of the project.

4. Data Scientists: Data scientists will be responsible for collecting, analysing, and interpreting data to optimise the system's performance and impact.

5. Community Engagement Specialists: Professionals skilled in community engagement will lead efforts to involve the public and promote awareness of the project.

6. Advisory Panel: The panel of advisors, as previously mentioned, will provide strategic oversight and guidance throughout the project's lifecycle.

The project governance structure and research team composition are designed to ensure that the blood delivery system project is effectively managed, receives expert guidance, and leverages a diverse set of skills and knowledge to achieve its objectives and maximise its impact.

7. PROJECT GOVERNANCE AND PARTNERSHIPS - Blood Delivery System for Last-Mile Accident Victims

Governance Structure:

The governance structure of the blood delivery system project includes a steering committee and a panel of advisors to ensure effective oversight, alignment with objectives, and adherence to project timelines.

1. Steering Committee: The steering committee comprises key project stakeholders, project leads, and representatives from relevant institutions. It will provide decision-making authority, oversee project progress, and address risks and challenges.

Advisors Incorporation:

The project will draw upon the expertise of a panel of advisors who will offer strategic oversight and guidance. The panel of advisors consists of three distinct categories:

1. Academic Experts: These experts bring academic guidance and research insights from relevant fields, contributing to the project's knowledge base.

2. Industry Professionals: Industry professionals provide practical insights, ensuring that the project aligns with real-world needs and trends, particularly in the healthcare and technology sectors.

3. Policy Advocates: Policy experts in healthcare and innovation contribute to the alignment of project outcomes with national and international policy objectives.

Partnerships:

The blood delivery system project has established strong partnerships with key stakeholders, including:

1. Directorate of Science, Technology, and Innovation (DSTI): DSTI serves as the project's Technical Supervisor and Guide, providing essential technical expertise and guidance.

2. DigitalBloodDelivery: A private sector company in Sierra Leone's healthcare sector, DigitalBloodDelivery collaborates with the project to support research, development, and testing activities.

Private Sector & Beneficiary Involvement:

The project actively engages private sector stakeholders in prototype testing and feedback sessions. These stakeholders play pivotal roles in refining the platform and introducing it to the market. Additionally, beneficiaries, including students and educators, actively participate in pilot programs, workshops, and focus groups to ensure the platform meets their needs and expectations.

University/Institute's Management Role:

The university/institute's management plays a critical role in the project by providing infrastructural support and ensuring compliance with institutional and national regulations. Their involvement contributes to the project's credibility and extended reach, as it garners institutional backing and support.

The project's governance structure and partnerships are designed to facilitate effective project management, leverage expert guidance, and ensure diverse stakeholder engagement, fostering the project's success and impact in Sierra Leone.

8. SUITABILITY OF THE HOST INSTITUTION - Blood Delivery System for Last-Mile Accident Victims

The selection of the University of Sierra Leone as the host institution for the blood delivery system project is exceptionally fitting due to various compelling factors, including:

1. Research-Driven Culture: The University of Sierra Leone is characterised by a research-driven culture that places a strong emphasis on innovation and scientific inquiry. The institution's unwavering commitment to research aligns seamlessly with the objectives of this project, emphasising the development and implementation of innovative solutions to address critical healthcare challenges in Sierra Leone.

2. State-of-the-Art Facilities: The university boasts state-of-the-art facilities, including the University Innovation Pod (UNIPOD), which serves as an innovative space for nurturing and developing ideas into practical solutions. This dynamic environment provides an ideal setting for the incubation and implementation of projects like the blood delivery system. UNIPOD, short for University Innovation Pod, offers an array of resources and infrastructure instrumental in supporting the project's research and development phases.

3. Educator Expertise: The University of Sierra Leone is home to a cadre of experienced and qualified educators with proven track records in similar projects. Their collective expertise spans various disciplines, including healthcare, technology, and data science. This wealth of knowledge ensures a multi-faceted approach to the project, drawing on diverse perspectives and insights.

4. Collaborative Networks: The institution has fostered robust ties with the private sector, including key industry players in healthcare and technology. These well-established relationships facilitate collaboration and engagement with private sector stakeholders, ensuring that the project benefits from real-world expertise and resources.

5. Educational Alliances: The University of Sierra Leone maintains strong relationships with other educational institutions, both nationally and internationally. These alliances open up avenues for collaborative research, knowledge sharing, and the exchange of best practices. Such networks are invaluable for a project of this scope, ensuring that it can draw from a broad spectrum of expertise.

6. Alignment with Research Strategy: The blood delivery system project aligns seamlessly with the institution's overarching research strategy, which emphasises technological advancements in various fields, including healthcare and education. This strategic alignment positions the project as a strategic initiative that embodies the university's commitment to innovation and knowledge generation.

In conclusion, the University of Sierra Leone's research-oriented ethos, cutting-edge facilities, expert faculty, industry connections, and collaborative networks make it an ideal host institution for the blood delivery system project. The university's commitment to driving technological advancements in education and healthcare positions it as a strategic partner in realising the project's objectives and impact. The University Innovation Pod (UNIPOD) within the university further underscores its dedication to fostering innovation and transformation in research and development.

9. CAPACITY BUILDING - Blood Delivery System for Last-Mile Accident Victims

The blood delivery system project is designed to serve as a dynamic hub for fostering both individual and organisational growth, focusing on various key aspects of capacity building:

1. Integration of MSc. Students: The project will actively involve Master of Science (MSc.) students, offering them invaluable hands-on research opportunities. These students will be integrated into the project's activities, working closely with the project team on the development of the blood delivery platform, data collection and analysis, model

development, and outreach activities. This active participation not only enriches their academic experience but also equips them with practical skills in the fields of healthcare, technology, and data science.

2. Engagement of Undergraduate Students: Undergraduate students will also play a crucial role in the project, ensuring the cultivation of a research culture from an early stage of their academic journey. These students will actively contribute to the project's objectives, enabling them to gain insights into the research process and develop a deeper understanding of healthcare innovation. Their involvement represents a unique opportunity for them to explore the intersections of healthcare and technology, preparing them for future roles in these critical sectors.

3. Capacity Building Workshops: The project will organise capacity-building workshops aimed at training students on how to effectively use the blood delivery platform. These workshops will not only empower students with the necessary skills to leverage the platform for educational and research purposes but also encourage them to explore the broader potential of technology in addressing healthcare challenges.

4. Webinars on AI-Driven Education: To keep students and participants abreast of the latest advancements in AI-driven education, a series of webinars will be conducted. These webinars will provide a platform for sharing insights, discussing emerging trends, and fostering a deeper understanding of the transformative potential of technology in education and healthcare.

By engaging MSc. and undergraduate students in the project, offering training through workshops, and facilitating knowledge sharing via webinars, the blood delivery system project serves as a catalyst for individual and collective capacity building. It not only equips students with practical skills and knowledge but also inspires a new generation of innovators to explore the intersection of technology and healthcare, ultimately contributing to the advancement of these vital sectors in Sierra Leone.

10. IMPLEMENTATION BUDGETING AND TIMELINES

Project 1: Blood Bank Establishment (Months 1-6)

Budget Allocation: \$20000

Project Overview:

The primary objective of this project is to establish a state-of-the-art blood bank facility that meets the highest standards of quality and safety. It involves the procurement of advanced blood testing equipment, the creation of temperature-controlled storage facilities, and the development of sterile processing areas. Staff training is a critical component to ensure that all personnel can handle blood products safely and effectively.

Detailed Activities:

- Procurement and installation of advanced blood testing equipment.
- Construction and setup of temperature-controlled storage facilities.

- Design and implementation of sterile processing areas.
- Training and certification of blood bank staff.
- Quality assurance and regulatory compliance assessments.

Project 2: Database Integration and Drone System Implementation (Months 7-12)

Budget Allocation: \$15000

Project Overview:

Project 2 focuses on two critical components of the blood delivery system: database integration and drone technology. The primary goal is to create a secure national blood group database that can be seamlessly integrated with the national identification system. Additionally, the project involves the procurement and implementation of drones equipped with temperature-controlled compartments for efficient and rapid blood delivery. Take-off and landing sites will be established strategically to support drone operations.

Detailed Activities:

- Development of a secure national blood group database.
- Integration of the database with the national identification system.
- Procurement and customization of drones with temperature-controlled compartments.
- Establishment of designated take-off and landing sites for drone operations.
- Testing and validation of the integrated database and drone system.

Project 3: Car Crash Alert System and Public Application Development (Months 13-18)

Budget Allocation: \$10000

Project Overview:

The final phase of the project is dedicated to enhancing the blood delivery system's accessibility and effectiveness. It involves the development of an advanced car crash alert system capable of automatically detecting accidents and notifying relevant authorities. This system will be integrated with GPS technology to precisely locate accident sites. Additionally, a user-friendly mobile application will be designed to facilitate blood requests and provide real-time tracking of blood delivery.

Detailed Activities:

- Design and development of the car crash alert system.
- Integration of GPS technology for accurate accident site identification.
- Creation of a user-friendly mobile application for blood requests.
- Implementation of real-time tracking features within the application.
- User training and awareness campaigns for the application's adoption.

Implementation Timelines:

The proposed project is estimated to be implemented over an indicative duration of 18-24 months.

Budget:

The overall budget for the concept is \$[Your Requested Funding Amount]. Budget allocations for each phase are as follows:

- Project 1: \$20000
- Project 2: \$15000
- Project 3: \$10000

Contact Person(s):

Principal Investigator: Dr. Ing. Salie Mahou (PhD)

- Email: [Coordinator's Email]
- Phone: [Coordinator's Phone]

Team Members:

- Ing. Mohamed Fofanah (BEng Hons Electrical, Electronics and Computer Engineering)
 - Email: [Contact Email]
 - Phone: +23275788481
 - Role: Artificial Intelligence(AI) and Internet of Things(IoT) Engineer
- Ing. Alfred Mbayoh (BEng Hons Mechanical Engineering)
 - Email: [Contact Email]
 - Phone: [Contact Phone]
 - Role: Mechanical Design Engineer
- Ing. Jarai Kuyateh (BEng Hons Mechanical Engineering)
 - Email: [Contact Email]
 - Phone: [Contact Phone]
- Ing. Sahr T. Nyalloma (MEng)
 - Email: [email]
 - Phone: [phone]
 - Role: Engineering Design Supervisor
- Dr. Edison Mustapha Bundeh (MBChB)
 - Email:
 - Phone:
 - Role: Medical Doctor
- Mr Francis Fomba Sesay (BSc Information Technology)
 - Email:
 - Phone: +23276066670
 - Role: Software Developer
- Ing Mohamed Kamara (BEng Electrical and Computer Engineering)
 - Email:
 - Phone: +23276066670
 - Role: Data Scientist and Engineer

10. MONITORING AND EVALUATION STRATEGY

Our monitoring and evaluation strategy is designed to ensure the effective implementation and impact assessment of the Blood Delivery System for Last-Mile Accident Victims. To achieve this, we have established a comprehensive framework:

Baseline Assessment:

- **Purpose:** Prior to initiating the project, a baseline assessment will be conducted to gather data on the existing state of emergency blood delivery in Sierra Leone.
- **Activities:** This will involve data collection on existing blood bank facilities, emergency response times, and overall blood availability.
- **Timeline:** The baseline assessment will be completed before the project's commencement.

Regular Checkpoints:

- **Purpose:** Quarterly reviews will be organised to assess the project's progress and identify any deviations from the set objectives.
- **Activities:** These reviews will involve project coordinators, stakeholders, and technical experts to evaluate the status of each project phase and address any challenges.
- **Timeline:** Quarterly reviews will be held throughout the project's duration.

Feedback Mechanism:

- **Purpose:** Continuous feedback loops will be established with all stakeholders, ensuring that any challenges or opportunities are promptly identified and addressed.
- **Activities:** Feedback will be actively sought from project participants, including healthcare providers, accident victims, and emergency responders.
- **Timeline:** The feedback mechanism will operate throughout the project lifecycle.

Outcome Evaluation:

- **Purpose:** After the project's completion, a thorough evaluation will be conducted to measure the project's impact against the anticipated outcomes.
- **Activities:** Independent assessments, surveys, and data analysis will be used to evaluate the effectiveness of the blood delivery system, including response times and lives saved.
- **Timeline:** The outcome evaluation will take place following the project's conclusion.

Data-Driven Analysis:

- **Purpose:** Key performance indicators (KPIs) will be defined, and data analytics tools will be employed to monitor these metrics throughout the project.
- **Activities:** We will use data analytics and data visualisation tools to track KPIs related to blood delivery efficiency, accident response times, and user satisfaction.
- **Timeline:** Continuous monitoring and analysis of KPIs will occur from project initiation to completion.

By adopting this integrated strategy, we aim to ensure that the project remains on track, deviations are promptly identified and rectified, and the overall impact of the Blood Delivery

System for Last-Mile Accident Victims is effectively assessed. This strategy supports transparency, accountability, and the achievement of our project's objectives.