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Call for paper - Abstracts

Performance of emergency mechanical ventilators in response to the covid-19 pandemic: an intercomparison study

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Emergency mechanical ventilators developed during the pandemic were used to meet the high demand in intensive care units to care for COVID-19 patients. An example of such ventilators is Masi, developed in Peru and installed in more than 15 hospitals around the country. This study aimed to compare Masi's performance with other emergency mechanical ventilators manufactured during the covid-19 pandemic such as Neyün, Spiro Wave and a prototype developed by the Faculty of Engineering of the National University of Asuncion (FIUNA). Three configurations of a test lung were used, combining different values of resistance and compliance (C1, C2 and C3). Ventilators were set to volume-controlled ventilation with tidal volume = 400 mL, respiratory rate = 12 breaths/minute, and positive end-expiratory pressure (PEEP) = 8 cm H2O. These parameters were measured in a series of ten two-minute tests which then were evaluated through a two-way analysis of variance, considering the type of ventilator and test lung configuration as the two independent variables. For target values, MASI delivered VT that ranged from 319 to 432 ml (-20 to +8%), respiratory rate of 12 bpm, and PEEP from 8.4 to 9.5 cm H2O (+5 to +20%). In contrast, for instance, Neyün delivered VT that ranged from 199 to 543 ml (-50 to +35%) and PEEP from 7.05 to 9.21 cm H2O (--11 to +15%), with $p<0.05$. The analysis of variance showed that he differences between preset and delivered parameters were influenced by the type of ventilator and, significantly, by the test lung configuration.*Clinical Relevance*— This establishes the most advantageous conditions in which three emergency mechanical ventilators work and a quantitative perspective in this topic.

Real-Time Motion Tracking in Virtual Reality: Integrating Movella Wearable Sensors with Vizard Using Python

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This study presents an innovative approach to real-time motion tracking for virtual reality (VR) applications by integrating Movella wearable sensors with the Vizard VR platform using Python scripting. We demonstrate how open-source system hardware, Bluetooth Low Energy (BLE), and Vizard's software architecture can be utilized to create a cost-effective and flexible solution for capturing human motion. Our method allows for the connection of multiple Inertial Measurement Units (IMUs) to a Bluetooth device, enabling real-time computation of kinematics essential for VR applications in rehabilitation, gaming, and biomechanical analysis. By leveraging Vizard's Python-based environment, we develop interactive 3D content and VR applications that respond to live motion data. Additionally, we incorporate the Laban Space Harmony (®LBMS) concept to guide patients' upper arm movement training, enhancing the engagement and effectiveness of rehabilitation exercises. This integration opens up new possibilities for immersive experiences and training, particularly in neurorehabilitation and human movement research, while providing

clinicians with detailed movement data for personalized therapy planning..

Keywords: Real-time Motion Tracking, Virtual Reality (VR), Inertial Measurement Units (IMUs), Quaternion-based Orientation. Python Scripting for VR

Happy me:

Gustavo Cosme[1]
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Problema

La depresión cada vez es más joven. La cantidad de adolescentes que sufren estrés, ansiedad y depresión solo va en aumento año tras año, y en la etapa universitaria, una de las más estresante, se empiezan a mostrar síntomas físicos y notamos las repercusiones en nuestra mente y corazón.

Solución

Nuestra propuesta es funcionar como un canal que une pacientes que necesitan estar bien con profesionales que saben cómo hacerlo y además llevar seguimiento del progreso.

Corporate social responsibility, social impact, and market return: a case study in an emerging market's oil industry

Edmundo Lizarzaburu[1]
1. ESAN

Corporate Social Responsibility (CSR) and social impact are two fundamental pillars of companies' strategy. However, to what extent these two dimensions affect market performance remains understudied in the case of emerging economies. To fill this gap, this paper examines the relationship between CSR and social impact in the oil industry in an emerging market (Peru). Using an adequate case study approach, together with financial data analysis, and the information provided by companies' annual reports and CSR reports, our results show that the expected positive relationship varies depending on many diverse factors. Specifically, for companies to achieve social impact, they must focus on community and environmental responsibility, along with stakeholder engagement. However, we find that companies that are weak on any of the above factors, only partially embrace social impact or even abandon it. Our results provide some relevant implications, not only for managers in the oil industry but also for policymakers. This issue is especially relevant in emerging economies like the Peruvian one since they are highly dependent on raw materials exports, which ultimately affects not only the environment but also the local communities.

Keywords: oil industry, corporate social responsibility, emerging market, social impact, case study.

ISO 31000 guide: Steps used in all type of organizations in Latam Countries.

Edmundo Lizarzaburu[1]
1. ESAN

This paper focuses on highlighting the importance of using ISO 31000 guide as a risk management guide for any organization due to its versatility. It shows the benefits of a correct risk management in companies and corporations; in addition to the components and applications of each principle of the ISO 31000 guide. It analyses the risk management process and how its applications in organizations can be found in many different departments, all for benefit of corporations to be successful. It emphasizes the significance of a continuous and cyclical approach to risk management, incorporating risk management into daily activities. Identifying and assessing risks are critical phases in any approaches, whether in strategic, operational, or information security. Risk responses must be planned, including mitigation, acceptance, transfer, or disposal. Internal and external stakeholder communication and consultation are critical. Finally, these approaches help to reduce uncertainty and make informed judgments in a variety of circumstances, ensuring company continuity.

Keywords: ISO 31000, Risk Management

Design And Optimization Of Rapid Polymerase Chain Reaction (Pcr) Coupled With Crispr-Based Detection Targeted At The Beta-Lactam Resistance Gene, Oxa-1.

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Introduction: Antimicrobial resistance significantly contributes to the current global health crisis. The blaOXA-1 gene—an extended-spectrum β-lactamase (ESBL)—has emerged as a formidable challenge due to its high prevalence resistance in the ESKAPE group, limiting the clinical use of routine beta-lactam antibiotics. Rapid and accurate detection of such resistance genes is essential for effective treatment [1]. Nevertheless, conventional microbiological tests can take a minimum of 32 hours to yield results [2]while rapid molecular tests can take up to 2 hours [3]. Furthermore, molecular detection tools are still limited to implemented laboratories slowing down a decentralized clinical diagnosis.

Here, we propose an innovative time-saving molecular detection assay based on PCR-CRISPR-Cas12a technology targeting the blaOXA-1 gene. By integrating a faster PCR assay with specific CRISPR-Cas12-mediated fluorescent detection, we offer a powerful and accesible tool that addresses the limitations of existing methods.

Methodology: By optimizing the termal ramp rate (TRR), the speed at which the thermal cycler transitions between temperature points [4], we evaluated the reduction in response time of a PCR-CRISPR-Cas12 detection assay. Here, we used bacterial strains harboring the blaOXA-1 gene for standardization. A TRR curve was performed between 0.8 and 2.2 °C/s to evaluate the target amplification of two different amplicon sizes, 300 and 500 bp.

This standardization allowed faster transitions between the denaturation, annealing, and extension steps in the PCR process, remarkably cutting down the overall cycling time. Finally, we standardized the OXA-1 fluorescent detection to evaluate the performance of our faster detection approach by CRISPR. To elucidate our assay detection limit, a DNA and cellular curve were conducted, assessing points from 1 ng to 100

fg DNA and from 101 to 108 colony formation units (CFU), respectively [5]

Results: By reducing the TRR from 0.8°C/s to 2.2°C/s, we achieved a 62.5% reduction of the PCR process time and, consequently, 50% of the turnaround time for our PCR-CRISPR-Cas12 assay. We took advantage of the faster temperature transition to reduce the time used in each PCR step to zero, shortening the amplification time from 1 h 20 min to 30 min, consistently amplifying as low as 10 pg as the traditional PCR assay. Our approach showed a cellular detection threshold of 102 CFU/ml at 20 minute-reading time.

Despite the overall reduced assay time—from 100 to 50 minutes (PCR: 30 min; CRISPR: 20 min) —sensitivity remains on par with traditional methods.

Conclusion: Our research concludes our PCR-CRISPR-Cas12a assay for OXA-1 fluorescent detection assay is a diagnostic tool that combines high speed and ease of use while maintaining a good technical sensitivity. The rapid PCR processing time, enhanced by CRISPR-based detection, further increases its potential for point-of-care (POC) testing, delivering results in less < 1 hour. It has proven to be a faster alternative, even competing with isothermal amplification methods. Its future implementation in clinical and research could greatly contribute to combat the spread of antibiotic resistance genes by enabling their field-based detection and in situ monitoring, crucial for global health surveillance and diagnostics.

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Real-Time Terrain Classification for Robotic Prostheses Using Deep Learning: Leveraging the ExoNet Dataset to Enhance Adaptive Mobility Across Diverse Walking Environments

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Introduction: The integration of advanced computer vision and deep learning techniques into assistive robotic devices, such as prosthetics, holds the promise of significantly enhancing user mobility and autonomy. This project focuses on developing a terrain classification model using the ExoNet dataset, a comprehensive collection of over 5.6 million RGB images depicting various walking environments. The primary objective is to enable robotic prostheses to dynamically adapt to different terrains by recognizing and classifying the environment in real-time.

Methods: In this project, I employ convolutional neural networks (CNNs) to construct the terrain classification model. The process begins with preprocessing the ExoNet images, which includes normalization,resizing, and data augmentation to improve the model's robustness against variations in lighting and weather conditions. The model architecture is based on a pre-trained CNN, such as ResNet, which is fine-tuned to recognize the specific terrain classes present in the dataset. Training involves using approximately 923,000 human-annotated images, ensuring effective learning of terrain distinctions. The model's performance is evaluated using standard metrics such as accuracy, precision, recall, and F1-score. It is also tested under various environmental conditions to assess its generalization capability.

Results: The deep learning model demonstrates promising performance in accurately classifying different terrains.

Evaluation metrics indicate high accuracy, precision, recall, and F1-score, reflecting the model's effectiveness in distinguishing between various terrain types. The model performs well across different environmental conditions, showcasing its robustness and ability to generalize from the training data.

Conclusions: This project successfully develops a real-time terrain classification system that can be integrated into the control algorithms of robotic prostheses. By detecting the terrain type, the prosthesis can adjust its gait patterns, providing a smoother and safer walking experience. For instance, the system's ability to detect stairs allows it to optimize movement for stair climbing or descending.

Future work: It involves integrating this terrain classification model into operational prosthetic systems, aiming to facilitate real-time adaptation of prosthetic behavior based on continuous terrain recognition. This integration is expected to reduce the cognitive load on users. Additionally, extending this model to other assistive devices, such as powered wheelchairs and exoskeletons, could broaden its application in mobility assistance. Furthermore, I plan to explore combining terrain classification with biosignal data, such as electromyography (EMG), to develop a more personalized and responsive prosthetic control system. This approach could lead to adaptive algorithms that anticipate user intent, further enhancing the functionality and user experience of robotic prosthetics.

TELENANU: Artificial Intelligence Serving Adolescent And Youth Sexual And Reproductive Health

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Teleorientation is a telemedicine service, which consists of a set of actions carried out through information and communication technologies to provide the user with information, counseling, and advice in a timely manner with ubiquitous access and quality of care. Sexual and reproductive health in Peru is a priority need on the country's public agenda, where all sectors are involved to prevent deaths, comorbidities, and negative social effects. A teleorientation prototype for sexual and reproductive health has been developed, employing artificial intelligence called "TeleNanu," aimed at adolescents and

young people.

The project's objective was to validate the generative artificial intelligence prototype for teleorientation in sexual and reproductive health in a real-world setting. The method is iterative and incremental, consisting of six stages: planning, collecting and organizing teleorientation content on sexual and reproductive health, configuring the technological platform and social networks, training the language model, testing and adjustments, launching, and promoting to the target audience. The expected results include contributing to reducing the gaps in access to timely and quality information on sexual and reproductive health through telemedicine.

TeleNanu is at maturity level TRL5, in a near-real environment. Its characteristics have been thoroughly tested with a selected group of users. An instrument has been designed to measure the quality of teleorientation, and a Teleorientation Model has been developed (establishing a cordial relationship, identifying needs, responding to needs, providing feedback, maintaining a cordial relationship, taking corrective actions, and implementing learning actions) based on the "Five-Step Model as a Basic Instrument for the Development of Orientation and Counseling with Cultural Appropriateness" of the Ministry of Health of Peru.

The knowledge base for Teleorientation in sexual and reproductive health has been developed, and the natural conversation flow with its respective scenarios (welcome, request for SSRH information, care centers, types of queries, farewell) has been designed to develop teleorientation. TeleNanu has the capability to track behavior patterns and monitor data related to teleorientation, responding specifically to questions and answers, identifying problems, and offering appropriate resolutions. Additionally, it can remember the user's name during the introduction phase in case they wish to use the service again.

The technological platform that houses TeleNanu is developed using Microsoft cloud technology. All the

components described above are integrated into this platform. In this new phase, we are working on the adoption of content with an intercultural approach and translation into Quechua. We hope to contribute to reducing the gaps in access to timely and quality information on sexual and reproductive health, creating pathways for communication in the mother tongue (Chanka Quechua - Ayacucho) through telemedicine, addressing vulnerable populations

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ESI-QTOF MS/MS Characterization of a Crotalus adamanteus Venom Myotoxin for Identification as a Potential Therapeutic or Molecular Probe.

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Snake venom, with its complex composition of proteins and toxins, has long been a fascinating subject of study due to its therapeutic potential and devastating effects [1][2]. The present study investigated the purification and characterization of a specific myotoxin, termed fraction P7, extracted from the venom of Crotalus adamanteus (Eastern Diamondback Rattlesnake). The aim of this study was not only to understand the structure and function of this toxin but also to explore its potential as a valuable biomedical tool.

The purification process of fraction P7 employed advanced techniques of molecular exclusion chromatography and ion-exchange chromatography. These methods allowed for the isolation of a protein with an approximate molecular weight of 20 kDa. Structural characterization, performed using ESI-QTOF MS/MS mass spectrometry [3], revealed an amino acid omposition rich in aspartic acid, glutamic acid, and other key amino acids.

This structure suggested a specific affinity of fraction P7 for cellular membranes, aligning

with the typical characteristics of phospholipases A2 (PLA2), known for their ability to cause severe muscle damage through membrane destabilization. Functional studies confirmed the high myotoxic activity of fraction P7 [4]. In cell cultures of C2C12 myoblasts and myotubes, fraction P7 exhibited significant lactate dehydrogenase (LDH) release in a dose-dependent manner,

approaching 100% in myotubes at concentrations of 20 µg/well.

This result demonstrated selective cytotoxicity towards differentiated muscle cells. Additionally, in murine models, intramuscular administration of 5 mg of fraction P7 resulted in a marked increase in creatine kinase (CK) levels, with a peak observed three hours after injection, reaching approximately 1800 U/L. These findings corroborate the ability of fraction P7 to induce severe muscle damage, especially when directly administered into tissue[5].

Structural analysis of fraction P7 by MALDI-TOF mass spectrometry confirmed its classification within the phospholipase A2 family, known for their high enzymatic activity and capacity to interact with lipid membranes [6]. This suggests a mechanism of action based on phospholipid degradation and subsequent disruption of the cell membrane. The results obtained in this study position fraction P7 as a promising molecule for therapeutic applications. Its ability to induce controlled necrosis in muscle tissue makes it an ideal candidate for developing new strategies in tissue regeneration or as a tool in the study of muscle diseases .

Additionally, its potential as a molecular probe for research in cellular signaling and pathogenesis suggests broad possibilities in the biomedical field. The findings of this research open new avenues for the biomedical application of snake venom-derived toxins [7]. Fraction P7, with its well-characterized myotoxic capacity, stands as a key platform for the development of targeted therapies and innovation in the design of specific treatments.

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Design of a Cotton-Polycaprolactone Mesh Reinforced with an Antibacterial Pectin-Honey Hydrogel for Postoperative Intestinal Anti-Adhesion in Hernia Repair.

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,

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Postoperative intestinal adhesions are a common complication following hernia surgery, causing chronic pain and obstructions. The meshes commonly used to reinforce hernia repair often contribute to forming these adhesions and can increase the risk of infections, complicating the patient's recovery. This study focuses on designing a biocompatible hernia mesh with an antibacterial hydrogel to promote intestinal anti-adhesion. A cotton fiber (Co) mesh will be designed, providing greater biocompatibility compared to commonly used materials like polypropylene (PP). This mesh will be handwoven using a basic single crochet technique between loops.[1] Additionally, it will be coated with polycaprolactone (PCL) through the Electrospinning method to provide greater mechanical strength and intestinal anti-adhesion.[2] The mesh will be characterized through microscopic images and mechanical tensile tests. Th e hydrogel was formulated from pectin and honey, and loaded with rifampicin to confer antibacterial properties. The hydrogel preparation will be optimized with the addition of polyvinyl alcohol (PVA) and hyaluronic acid (HA) using the freeze-thaw (FT) method.[3] To overcome the long processing time of the traditional freeze-thaw method, a small molecule of 3,4-dihydroxyphenylacetic acid (DHPA) will be introduced to promote the formation of the composite hydrogel.

In the hydrogel characterization, the antibacterial property will be evaluated in vitro through a sequential diffusion test in agar wells to assess the performance of the hydrogels.[4] Uncoated meshes and meshes coated with pectin-honey and rifampicin will be placed on inoculated LB agar plates, and incubated for 24 hours at 37°C, and inhibition zones will be photographed. Regarding the hydrogel's mechanical test, it will be carried out using a mechanical analyzer, with

cylindrical hydrogel samples. Finally, in vivo experimentation will be conducted through abdominal surgeries in rats, where postoperative monitoring will provide results on intestinal adhesion and bacterial infections. Biocompatibility and cell viability will be analyzed through histological evaluation.[5] Additionally, the inflammatory response and tissue regeneration around the implanted mesh will be observed. It is anticipated that the mesh will achieve good results in terms of biocompatibility and intestinal anti-adhesion and that it will meet the required parameters in the mechanical tests for a surgical hernia mesh. Furthermore, it is expected that the composite hydrogel will promote good peritoneal regeneration, thereby preventing the formation of postoperative intestinal adhesions and alleviating the inflammatory response.

This study contributes to the improvement of the design of surgical meshes used in hernia operations, offering more optimal solutions for patients, preventing subsequent surgeries, and avoiding lifelong discomfort.

Key words. Hydrogel, hernia, surgical mesh, intestinal adhesion, bacterial infection.

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V.TRACKER: A Python Package To Automate Search For Emerging Sars-Cov-2 Variants.

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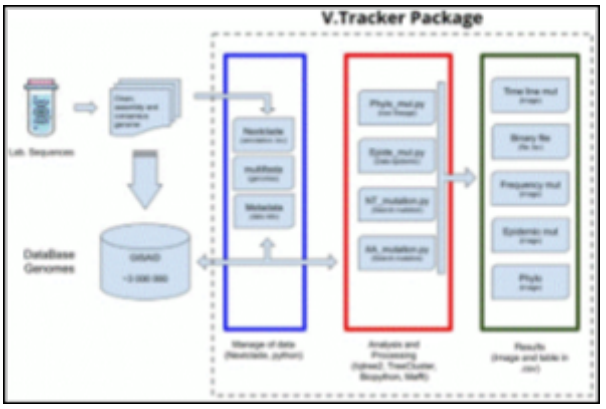
Abstract: — Identifying the emerging lineages of SARS-COV-2 becomes a constant process, although there are tools that allow the classification of the new reported genomes based on prior manual curation. There are few programs that allow manual healing to be carried out more automatically. We developed V.Tracker, an automatic program that detects emerging lineages, locates them at a phylogenetic level and reports their associated mutations.

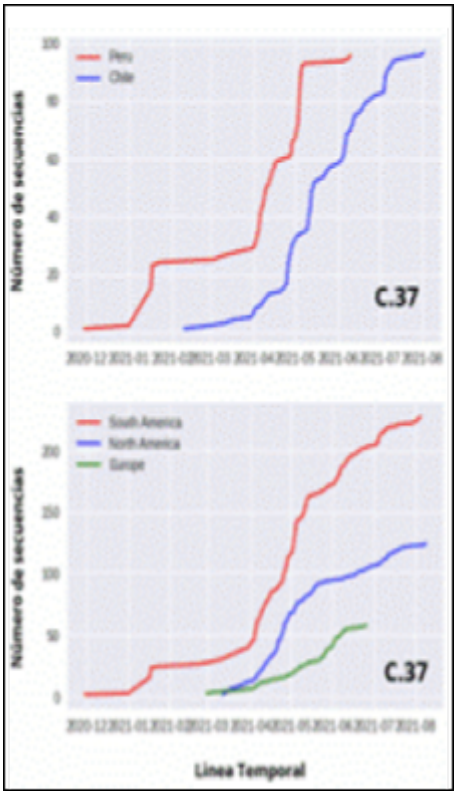
Keywords — SARS, Covid, phylogeny, mutations, Python

Introduction: Since the appearance on December 30, 2019 in Wuhan, China of coronavirus type 2, COVID-19 has caused more than 216 million infections and 4.5 million deaths around the world. Faced with this situation, the response of the scientific community was sequencing and studying the SARS-CoV-2 genome which has generated SARS-CoV-2 genomes in real time. The goal is to identify and to propose the new genomic variants of SARS- CoV-2 that are appearing so that they can have epidemiological relevance. In order to achieve this, there is a methodology called Pango nomenclature [1], which complements the SARS-CoV-2 NextStrain and GISAID nomenclature systems [2, 3]. These systems are based on the identification of broad phylogenetic clades. The Pango nomenclature system is hierarchical, fine- scale and seeks to identify phylogenetic clusters of epidemiological relevance.

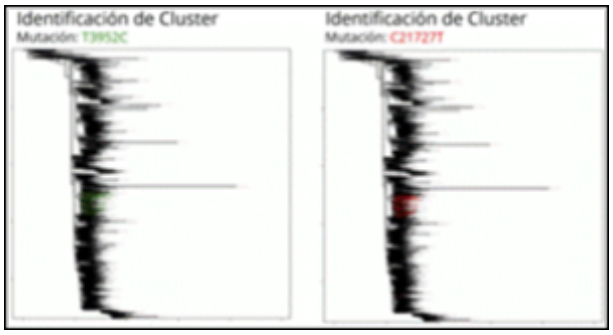
In this work, a computational tool was developed using the Python programming language named V.Tracker, which implements the Pango nomenclature methodology for the identification of new variants that may be of concern from an epidemiological point of view. The V.Tracker was implemented seeking to have compatibility with SARS-CoV-2 genetic sequencing data that has not yet been processed by the NextStrain and GISAID systems, which allows immediate adaptability to the SARS-CoV-2 genetic sequencing information. 2 that appears quickly. Additionally, V.Tracker contributes to the development of computer systems that perform the task of identifying variants, a process that, currently, is most frequently done manually.



Pic. 1. V.Tracker information flow. The package is made up of four modules that process GISAID sequences and metadata.



Pic. 2. Reported genomes of C.37 in GISAID (December 2020 to August 2021)



Pic. 3. Phylogenetic trees and identification of cluster sequences with the T9352C and C21727T mutations

References:

Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, and should use the following abbreviated style:

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BIOHEART: Design And Implementationof A Low-Cost Portable Electrocardiogram.

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Introduction: As reported by the WHO, cardiovascular diseases are the leading cause of death worldwide [1]. In Peru, mortality from these diseases has increased, particularly in remote regions with limited access to advanced medical equipment [2].

Methodology: This study involves the development of a low-cost, portable ECG device using an Arduino Uno, an AD8232 sensor, and a 2.8" TFT LCD screen. The Arduino Uno acts as the central processor, gathering data from the AD8232 sensor, which captures and filters the heart's electrical signals. These signals are processed by the Arduino and then displayed in real-time on the LCD screen, providing a visual representation of the ECG waveform, including key features like P, QRS, and T waves. The device's design includes a schematic diagram outlining the connections and signal processing, ensuring accurate and continuous cardiovascular monitoring.

Results: The low-cost portable electrocardiograph was evaluated using the Fluke Prosim 8 vital signs simulator. The tests confirmed its ability to accurately isolate the R waves, QRS complex, and T wave, as well as handle noise and artifacts. The device demonstrated effective response to various BPM frequencies and performed well in simulating ECGs for healthy patients and those with conditions such as hypertension, hypotension, tachycardia, bradycardia, ventricular fibrillation, and asystole, showing its precision (>90%) in representing different health states.

Discussion : Based on the results obtained from the low-cost portable electrocardiograph, its performance is comparable to standard market devices, accurately measuring BPM from 20 to 230. Although waveforms with amplitudes greater than 1.75 mV showed some distortion, the device performed well for lower amplitudes. Compared to a commercial device, this electrocardiograph has achieved a 50% cost reduction, providing a more affordable solution without compromising accuracy.

Conclusions: In conclusion, due to its efficiency and low cost, the device has the potential to democratize access to critical cardiac monitoring technologies and advance telemedicine, thereby improving the diagnosis and treatment of heart diseases in resource-limited communities.

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Innovative Method For Producing, Isolating And Purifying Natural Isothiocyanates From Glucosinolates.

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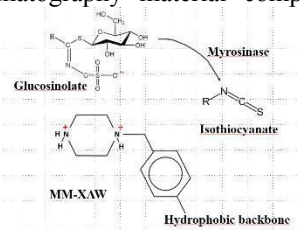
Introduction: Isothiocyanates (ITCs) are biologically active hydrolysis products of glucosinolates (GCS) by the action of myrosinase enzyme and they are abundant in Brassicaceae vegetables (broccoli, kale, cabbage, cauliflower, mustard, wasabi, etc). Each GCS forms a different ITC when its hydrolyzed**.**

ITCs have demonstrated strong antioxidant anti-inflammatory activities, as well as antibacterial and potent anti-cancer activities.

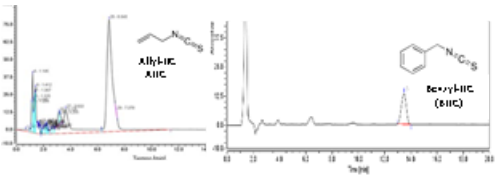
At present, there are many reported methods for isolating ITCs, which include several steps of extraction, use of large quantity of organic solvents, long extraction times required, additional purification, thus making a large-scale process very inefficient and time consuming, adding a very high cost to the overall process.

In view of this, there is an urgent need to develop a method for isolating and purifying ITCs which will be safe, simple, environmental friendly and can be used in industrially production to provide ITCs of high-purity and high-quality so as to satisfying the growing medicinal and pharmaceutic industrial production needs.

Method: The present invention relates to a method for producing and purifying ITCs from a GCS mixture using a mixed mode (MM- WAX) chromatography material comprises ion exchange functional groups (IEX) and hydrophobic interaction functional groups (HIC) operated in flow through mode, wherein the GCS are anionic and hydrophilic compounds, while ITCs are hydrophobic compounds. Sample aqueous preparations protein free to be applied may include purified or partially purified GCS from natural, synthetic or recombinant sources, which are captured by IEX phase of the WAX resin. Then, GCS captured are hydrolyzed by Myrosinase enzyme treatment incubation producing ITCs, which are simultaneously adsorbed by HIC of the same WAX resin, avoiding their degradation and the use of toxic organic solvents. Finally, the ITCs are eluted from WAX resin by an alcoholic solution.



Results: Figures show HPLC chromatograms of AITC and BITC purified through of MM chromatography after hydrolysis of GCS Sinigrin (standard) and a plant extract, respectively.



It obtained has high efficiency (96%) and huge purification of ITCs up to 85%

Conclusions: the invention adopts an environment-friendly process and it has the advantages of low cost, simple, efficient, it is a continue process and strong feasibility. ITCs obtained by the invention has high purity and could be produced in large scale.

References: WO2024/039253A1 Method for producing, extracting, isolating and purifying Isothiocyanates from Glucosinolates

Optimizing Emergency Room Patient Flow: A Simulation-Based Approach to Reducing Wait Times. J. A. Gallarday[1] and A. M. Gonzalez[2], 1juan.gallarday@utec.edu.pe, 2angel.gonzalez@utec.edu.pe.

Introduction: The COVID-19 pandemic generated abrupt changes in the emergency sector, proving the importance of rapid care and the efficient use of resources in hospitals. This study was carried out in the emergency sector of a Private Hospital, where, in 2023, 112,172 arrivals were registered. After the pandemic there has been a yearly increase of arrivals in the emergency room, for example, 2022 saw a 74% increase in patients from 2021 and 2023 saw a 24% increase from 2022. Overall, patient arrivals

increased by 3% in 2023 when compared with pre-pandemic levels.

Methodology: To carry out this study, the DMAIC (Define, Measure, Analyze, Improve, Control) methodology was used as the framework for the project. For an initial problem analysis, the Critical Incident Approach method was used. During the investigation, due to the non-linear nature of patient visits, an agent based simulation was developed to verify the effect of a low complexity differentiated flow. As a result, the low complexity differentiated flow was implemented in the hospital and its effect was measured. Furthermore, other tools based on Lean methodology were also implemented to gather information on a deeper level to propose improvements.

Results: Our analysis identified timeliness as the performance dimension with the largest gap between importance and satisfaction. The simulation predicted a 35% reduction in waiting times using the low-complexity differentiated flow. However, it also revealed a discrepancy in room utilization between the simulation and reality, with rooms never fully used in practice. The actual implementation results were even more promising, showing a 50% reduction in waiting times and a 33% reduction in total patient time. We focused on these objective metrics rather than subjective patient satisfaction surveys to evaluate the intervention's success.

Conclusions: This study demonstrates that in a complex service such as an emergency room, the Critical Incident Approach is a valuable tool for determining important dimensions of patient experience. Agent-based simulations prove useful for modeling interventions in non-linear, complex processes with high variability, although real-world implementation may reveal discrepancies. The implementation of a differentiated patient flow for low-complexity patients, who represent close to 50% of all ER visits, can significantly reduce patient waiting times and improve overall efficiency.

Future Directions: Based on these positive outcomes, we plan to share the DMAIC methodology with public hospitals through online courses at a national level. We also aim to promote the use of the Critical Incident approach for all patient-facing areas of hospitals to improve overall patient satisfaction and experience. Future work will focus on refining simulation models to better reflect real-world conditions, particularly in areas such as room utilization. The success of this approach warrants sharing with other healthcare facilities and potential implementation in other patient-facing areas of the hospital.

References: Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, and should use the following abbreviated style:

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MABIS is a breast anomaly detection system called Microwave Analyzer for Breast Imaging Scanning, in the poster we present the results in Iren-Sur.

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Breast cancer is the most prevalent neoplasm in the country, primarily affecting women over the age of 35 [1]. This constitutes a public health issue that is currently being addressed with costly and large equipment that cannot be distributed equitably

throughout the country. This, combined with the increasing number of patients, creates challenges.

The present report compiles measures and real results on the use of a breast anomaly detection system called Microwave Analyzer for Breast Imaging Scanning (MABIS), which is an accessible and more maneuverable alternative compared to commercial options like ultrasound, mammography, and magnetic resonance imaging.

The system emits radiofrequency signals through 16 antennas arranged around a conventional bra, and based on the breast's response to this stimulus, images are formed. The controlled parameters are the medium's permittivity and the height at which the anomaly is presumably located. The system generates a two-dimensional image using the delay and sum (DAS) and delay-multiply-and- sum (DMAS) algorithms [2-4].

The target patients are around 50 years old, including women with a history of cancer, those undergoing treatment, and those who simply want to rule out any issues. To obtain a validated reference from a commercial device and interpreted by a professional, breast ultrasounds are performed on all patients who wish to take the test.

Once the images and ultrasound reports are obtained, alongwith the res ponse from the MABIS system, both images are compared to determine the accuracy and effectiveness in correctly detecting any breast anomaly or, conversely, confirming the result as a healthy breast.

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Cleveland Clinic - UTEC Challenge

Removal of microplastics by manufacturing 2D-MOF with C@FeO nanoparticles

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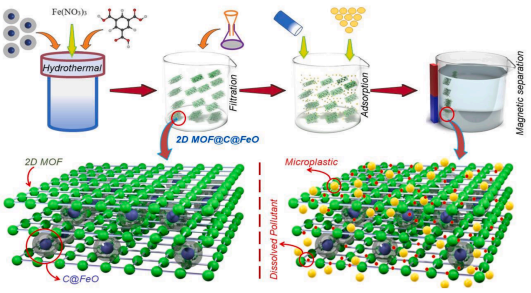


Graphical Abstract

Introduction: Microplastic pollution in the oceans is a global problem that affects marine life and human health.

These tiny fragments of plastic smaller than 5 mm are a consequence of the incomplete degradation of plastics used in various sectors such as the medical area, transportation, among others. For example, wet wipes, disposable cardboard with an internal plastic cover, filtering tea bags, among others. These materials are widely dispersed and are difficult to remove with conventional methods such as traditional filter nets and photodegradation are not efficient as membrane adsorption. With all this, the idea of placing magnetic nanoparticles on the membrane will help the extraction of microplastics, bringing greater efficiency in filtration.

Results and Discussion: To test the adsorption of microplastics (MP) and methylene blue (MB), tests such as DLS (Diffraction Light Scattering), UV-vis (ultraviolet-visible spectroscopy) and TGA (thermogravimetric analysis) are used. These allow us to calculate the size, quantify the adsorption and the weight of the microplastic respectively, of the MOF, the C@FeO and the 2D MOF@C@FeO.

After performing the corresponding tests, the following results were obtained: the adsorption of MP and MB by the C@FeO is lower compared to 2D MOF and 2DMOF@C@FeO, which demonstrated an adsorption capacity of 68.5% and 100%, respectively. [1]

Table 1. Absorption percentage of microplastics (MP) and methylene blue (MB)

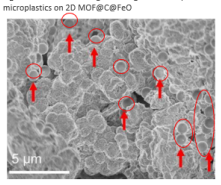
Material	Microplastic Absorption	Absorption of methylene blue
C@FeO	42,00%	<10%
MOF 2D	68,5%	<10%
2D MOF@C@FeO	100%	100%

Note: *Data extracted from [1]*

However, 2D MOF cannot be easily reused because its extraction from the solution involves two steps: filtration and centrifugation. On the other hand, 2DMOF@C@FeO, thanks to the magnetic properties granted by the C@FeO (7 emu/g), allows for simpler extraction using a magnet. Similarly, the adsorbent is capable of adsorbing 1000 mg of microplastics with an initial concentration of 3000 mg/L in about 1 hour, the best thing about this material is its ability to be reused up to 6 times with an adsorption capacity between 100% - 90%, also in extreme pH conditions (2.5 - 12.5) its adsorption percentage is 100% - 80%, on the other hand, at high temperatures (40°C - 60°C) its adsorption percentage is 92% - 90.6%.

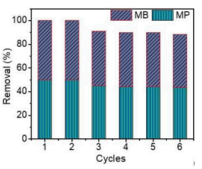
This adsorption property is due to its large contact surface with the microplastic solution. Although, its ability to be reused up to six times without significant damage to the membrane is thanks to its three-dimensional structure with nanopillars, which, metaphorically, resembles sheets stacked on top of each other but separated by small marbles, where the leaves represent the 2D MOF and the marbles the nanoparticles of C@FeO. Having said that, we consider it important to extend this research by comparing the concentration of microplastics in the initial solution and in the final solution after the adsorbent material has been applied, through a UV-vis test.

Figure 3: Ex situ SEM image showing clear adsorption of microplastics on 2D MOF@C@FeO



Note: *Scheme retrieved from [1]*

Figure 4: Reusability and stability of 2D MOF@C@FeO in six MB and MP adsorption cycles



Note: *Scheme retrieved from [1]*

Conslusion: Microplastics are a problem with a great impact on marine life and the methods used for their adsorption are inefficient unlike the

three-dimensional structure of 2D MOF with C@FeO nanopillars, giving it better stability and a larger surface area for greater adsorption in less time. These characteristics allow the material to be reusable, making it a promising candidate for large-scale industrial applications in water purification.

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Transcutaneous Electrical Nerve Stimulation (TENS) for the Treatment of Symptoms of Osteoarthritis in the Hand

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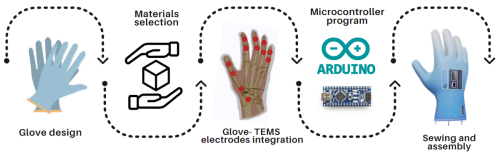


Graphical Abstract

Introduction: Osteoarthritis is a chronic and inflammatory disease that primarily affects the synovial membranes of the joints, mainly manifesting in people over 50 years old. According to Arenas (2018), the prevalence of osteoarthritis is significantly higher in Peruvian women (49.7%) compared to men (25%). Additionally, the Plataforma del Estado Peruano (2023) reports a 30% increase in recent years, driven by the rise of teleworking due to the COVID-19 pandemic.

To relieve pain and stiffness, treatments such as medications and physical therapies are employed, although these require visits to specialized centers or the use of inconvenient ointments. In the market, there are gloves with innovative functions, such as heating (IMAK, Orthosleeve, Tommie Copper), vibration (Quantic Nanotech, Intellenetix), and TENS technology (Sensamed, TENS 7000 Conductive Gloves, KONMED), although the latter require external electrostimulation devices. Therefore, the aim of this study is to integrate TENS technology directly into the gloves to provide a practical and efficient solution for the treatment of osteoarthritis.

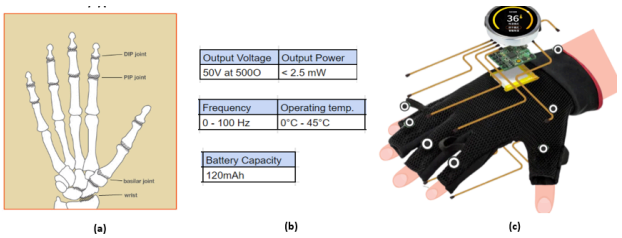
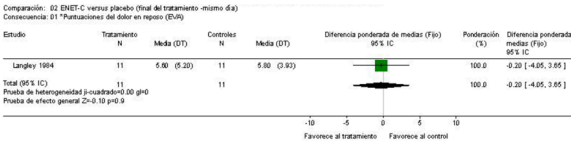


Figure 2. (a) Joints Most Affected in OA (b) List of Materials for the Prototype (c) Sketch of the Glove with Custom Modifications

Results and Discussion: The research on the effect of TENS involved a systematic review of published studies. Independent reviewers used pre-developed data collection forms to record specific information about TENS-C therapy versus other placebos such as ointments, vibrators, etc., as indicated in Table 1. The same reviewers assessed the methodological quality of the studies,

including evaluating the extent to which study design, data collection, and statistical analysis minimized or avoided biases in treatment comparisons. They concluded that TENS-C therapy was slightly superior to the placebos.

Table 1. TENS-C vs. Placebo (Same Day) Resting Pain Scores (VAS)



The treatment duration, ranging from 20 to 50 minutes with an average of 30 minutes per session, has shown to produce good results in terms of pain relief and improved mobility. It is crucial to use devices with modulated current forms to maintain the therapy's effectiveness over prolonged sessions.

The main contributions of this work lie in the innovation of a portable, hand-specific device that allows for more focused and comfortable administration of TENS. Recommendations for future work include optimizing the current waveform and exploring new electrode configurations to maximize comfort and treatment efficacy. Additionally, further investigation into the ideal treatment intervals and the impact of prolonged low-intensity stimulation on treatment effectiveness is suggested. The application of these results could extend to other types of chronic pain diseases, providing a non-invasive and accessible alternative for improving patients' quality of life.

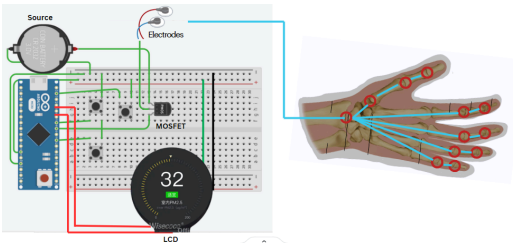


Figure 4. Electronic Schematic

The results obtained point to the feasibility and efficacy of integrating TENS technology by designing therapeutic gloves for osteoarthritis treatment, offering a practical alternative for patients affected by the chronic disease. Compared to similar commercial solutions such as the one studied by Jamison (2018), do not offer an affordable price for the Peruvian population (~ S/476). Alternatively, out solution is much more accessible (S/70).

Conclusions: This study aims to alleviate the symptoms of osteoarthritis by integrating TENS technology directly into therapeutic gloves. To achieve this, low-cost materials were used, assembled with sewing techniques, and programmed with Arduino. The results indicate by ENET-C therapy have shown to be more effective in relieving pain and improving mobility compared to other treatments.

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Micronne: A device based on biodegradable microneedles patches for the treatment of *acne vulgaris*

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Graphical Abstract

Introduction: Acne vulgaris is a common skin disorder associated with sebaceous glands that affects more than 80% of the world's population. Acne can be caused by a variety of factors, including genetic, hormonal, infectious and environmental. In Peru, acne vulgaris also poses a significant challenge to the dermatological health of the population, necessitating effective solutions tailored to local needs. Given this issue, it is essential to develop innovative and effective treatments to address acne vulgaris effectively and improve the quality of life of those affected. In recent times, there has been extensive research conducted on microneedles. As a new minimally invasive transdermal drug delivery system, it can penetrate the stratum corneum of the skin, improve the release rate and bioavailability of the drug, and overcome the disadvantages of slow bioavailability of traditional patches. The aim of this project is to develop a device that allows an innovative and effective treatment of acne vulgaris with natural polymers and drugs to improve the quality of life of patients.

Results and Discussion: The preliminary result is available for the design of the

Micronne device and the integration of the microneedles patches.

The design was developed in Autodesk Fusion and the dimensions were determine according to the Table 1. The main parts of the device are the handle, a retractable button to only use the central internal area of the microneedle patch, the patches of two different sizes (big and small), the Intense Pulsed Light (IPL) emission flash lamp and a power button to turn on and off the flash lamp (Figure 3).

Table 1. Dimensions of *Micronne*

Type	General Size			Patches		Microneedle	
	Length (mm)	Width of internal circular base (mm)	Diameter of circular base (mm)	Length x width x height - small patch (mm)	Diameter x height - big patch (mm)	Diameter base (mm)	Height (mm)
Dimensions	174	70	78	18 x 18 x 0.5	70.5 x 0.5	0.0517	0.9

This device would be made of acrylonitrile butadiene styrene (ABS) due to their mechanical and thermal properties. According to A. Milovanović et al., ABS compared to other similar materials such us polycaprolactone (PLA), it has better mechanical properties, sufficiently higher printing speeds and higher heat resistivity [1], [2]. Based on this, ABS is the ideal material to resist high temperatures and withstand possible device drops.

The dimensions were chosen according to the ranges mentioned in this study: 50–900 µm long [3]. Also, the general measurements are set according to what

R. Parhi mentioned about the microneedle geometries (includes length, base width, and tip diameter), which should vary from 150 to 1500 µm in length, 50 to 250 µm in base width and 1 to 25 µm in tip diameter [4]. The dimensions of the microneedles should be appropriate in order to minimize pain during injection.

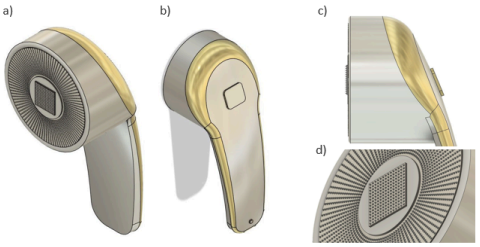

Figure 3. 3D CAD Model of the *Micronne* device. a) Front, b) back, c) profile view and d) microneedles view.

Regarding the microneedles patch would be made of EGCG/BSP/HA because of the BSP is a natural soluble polymer with wound healing, anti-inflammation, anti-oxidation, and immune regulation properties. [5]. EGCG are polyphenolic catechins to inhibit proliferation in the treatment of acne and lipid synthesis of sebaceous gland cells [5] and lemongrass essential oil has antibacterial properties against P.acnes thanks to the three specific compounds: α-citral, ß-citral and myrcene. [6]

Conclusions: To sum up, this device will allow to treat *acne vulgaris* with natural polymers and drugs to improve the quality of life of patients through microneedle patches and the action of IPL. This dermatological device can offer numerous advantages over traditional treatments. By enhancing the efficacy of drug delivery, reducing side effects, increasing patient comfort, stimulating skin regeneration, and allowing for treatment customization. This leads to faster, more effective results and improves the quality of life for patients.

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Intravenous access simulator

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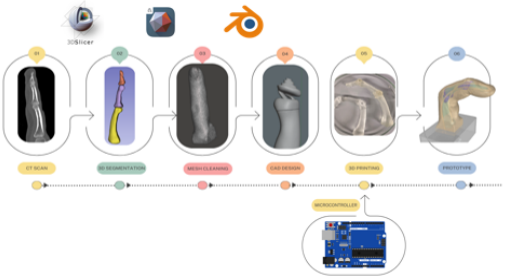

Graphical Abstract

Introduction: There are advanced surgical interventions, such as performing closed reductions and percutaneous screw insertion for fractures, that demand the development of three-dimensional spatial competencies and the application of tactile and visual feedback to ensure successful intervention (Prsic et al., 2020). These challenging techniques require a significant amount of practice to be effectively taught and learned (Brichacek et al., 2018).

It has been noted that practice prior to surgeries allows trainees to optimize their learning sessions (Prsic et al., 2020). However, additional "hands-on" training in the operating room under surgical supervision for surgeons-in-training is time consuming for an experienced surgeon, which could compromise patient safety and raise ethical issues, because the use of patients as training subjects (Maier et al., 2020). The benefits of surgical simulation include decreased time spent on instruction of fundamental concepts, optimized utilization of real cases, increased number of cases, effective transfer of skills from the simulator to the operating room. These surgical simulators offer students the opportunity to hone their skills in surgical procedures within a safe and accessible environment (Brichacek et al., 2018).

Methods: First, the bones of the hand were segmented using 3D Slicer. The segmented models were exported to Meshmixer to clean the mesh and ensure proper design. After cleaning, the models were imported into Blender to optimize the meshes and incorporate a rolling joint design. The phalanges and joints were then 3D printed using resin. Initially, the joints were printed

in resin, and later a two-part mold was created to produce them in silicone.

For the electronics, a Corona CS238MG servo was used to move three cables simulating ligaments, controlled by a Xiao ESP32. Finally, the entire assembly was coated with silicone to simulate soft tissue, with pore texture and interphalangeal lines.

Figure 2. Key moments of prototype manufacturing

Results and Discssion: Intravenous access in the hand is one of the most common locations for the administration of intravenous medications, cardiac drugs, chemotherapy, blood transfusions, or hemodialysis. For medical and nursing students, practicing this technique is essential. In this regard, the intravenous access simulator offers several advantages compared to static models. This type of simulator allows students to practice the technique on a moving hand, simulating the real conditions of a live patient who moves due to fear or discomfort. The movement of the hand adds difficulty to the technique, which helps improve the students' psychomotor skills. Figure 3 shows in more detail each of the parts that make up the simulator.

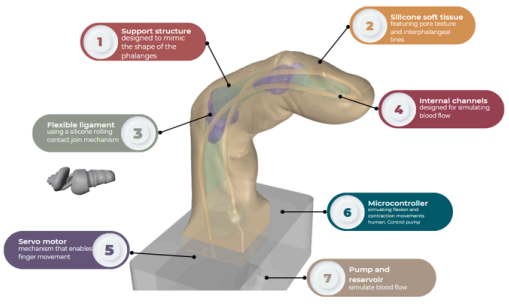

Figure 3. Specific features and parts of the simulator

There are few medical hand simulator models specifically designed for injection training. A couple of outstanding examples include the work of Adnan Prsic and his team, who have created a realistic and robust 3D model with interchangeable bones. This model allows training essential motor skills to correctly perform fracture fixation of the hand and wrist using K-wires, all in a home environment. Their low-cost 3D hand model of is highly realistic and durable, with bones that can be changed, making it ideal for inclusion in hand surgery curricula in home environments. On the other hand, the team led by Michal Brichacek has developed a realistic 3D hand model useful for teaching residents about common hand fractures, such as Bennett's fracture. In this model, the bones are made of a polyurethane foam with iron to simulate radiopacity, and the soft tissues are made of silicone of different viscosity grades.

Conclusions: This simulator not only optimizes the simulation of intravenous access in the hand but can also be enhanced to replicate other complex surgical procedures in the hands, such as closed reduction and the placement of percutaneous pins in fractures. This first prototype demonstrates that it is possible to manufacture different body parts and create more cost-effective simulators with improved features for various types of emergency procedures. Ultimately, this highlights the great potential for developing simulators that can enhance medical training across a wide range of areas.

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Hydrogel patch of methacrylated alginate microneedles for the treatment of type 2 diabetes (DM-2) patients suffering from grade 0 to 3 ulcers on the Wagner-Merrit scale in Peru

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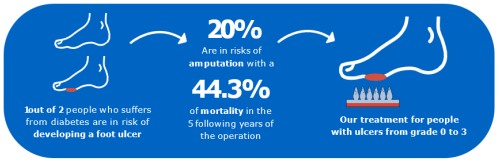
Bioengineering Students.



Graphical Abstract

Introduction: Diabetes is a chronic disease that affects **387 million** of people worldwide. Type 2 diabetes (DM-2) accounts for approximately **90% of all the cases** around the world. This condition can lead to serious complications, being foot ulcers one of the most critical [2].

In Peru, according to the *"Global Burden of Disease – 2019,"* DM-2 was the **sixth leading cause of death** for both sexes. Every year, at least **8000 amputations** are performed on people with diabetes in the country. This high incidence of severe complications highlights the need of a better wound healing solution to reduce the risk of amputation.

Therefore, our project focuses on people with **type 2 diabetes, between 0 - 3 stages of foot ulcer on the Wegner Scale, in Peru**. This group is particularly vulnerable to developing neuropathic and neuro-ischemic ulcers, which can lead to amputations.

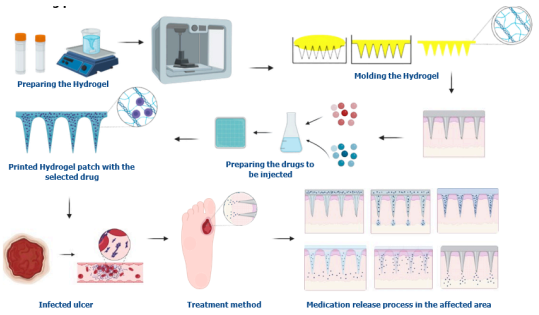
Methods: Foot ulcers in people with type 2 diabetes (DM-2) typically develop due to a combination of diabetic neuropathy, poor blood flow, and excessive pressure on certain areas of the foot. Neuropathy causes a loss of sensitivity, leading people to be unaware and ignore minor injuries that can progress to ulcers, while poor circulation limits blood flow and the body's healing capacity [3].

Grade	Type of lession	Characteristics
0	None. At-risk foot.	Hyperkeratosis.
1	Superficial ulcers.	Full-thickness skin destruction.
2	Deep ulcers.	Penetrates skin, fat, and ligaments. Infected.
3	Deep ulcers with abscess.	Osteomyelitis. Secretion and foul odor.

Wagner-Merrit Classification System (1981)

The conventional treatment of diabetic foot ulcers includes the removal of dead tissue, the use of appropriate dressings, the management of infections with antibiotics, and blood sugar control. In replacement of this, to treat grade 0

to 3 DM-2 ulcers, **we propose the following process:**



To develop a **Methacrylated alginate, chitosan nanoparticles and fucoidan hydrogel patch with microneedles**, gelatin and methyl methacrylate were synthesized, facilitating the formation of a crosslinked hydrogel network under controlled conditions. Subsequently, mesenchymal cell exosomes (MSCs) and the drug tazarotene were integrated into the hydrogel through encapsulation techniques in microneedles, using a PDMS mold design to ensure the structure and functionality of the patch. The characterization of the microneedles involved studies of controlled release of

drugs and exosomes, evaluating their efficacy through cell cultures. This method allows the creation of a localized and minimally invasive delivery system.

Expected Results: It is expected to significantly accelerate the healing process compared to conventional treatments, while promoting the regeneration of damaged skin tissue. Additionally, the hydrogel is expected to have solid mechanical properties, excellent adhesion across a wide range of temperatures, and extensive and long-lasting antibacterial activity to prevent infections that could lead to an amputation.

The application method involves using a hydrogel patch with microneedles that will be placed directly on the ulcer-affected area. This approach aims to prevent infection and initiate an effective healing process. The microneedles facilitate the localized delivery of therapeutic agents directly into the wound, enhancing the penetration and effectiveness of the treatment. This method ensures that the medication reaches the deeper layers of the skin, promoting better absorption and providing a controlled release of the active ingredients. By targeting the ulcer site precisely, the patch not only helps in reducing infection risks but also accelerates the wound healing process, offering a promising solution for patients with diabetic foot ulcers.

We expect our patch to be efficient for rapid healing and infection prevention for the following reasons: a significantly accelerated wound healing is estimated in type 2 diabetic models, showing a notable improvement in less than a month. This system optimizes drug release, overcoming challenges such as low solubility and rapid degradation, and establishes a robust vascular network that enhances nutrient and oxygen delivery to the damaged tissue. Additionally, the patch promotes cell migration, angiogenesis, and reepithelization, facilitating effective tissue recovery. The patch is estimated to achieve a 45.1% release of tazarotene, compared to conventional methods that suffer from low absorption and effectiveness due to barriers such as solubility and premature drug degradation. Especially for those suffering from diabetic complications, it has considerable potential to prevent severe complications, including amputations.

To illustrate the expected outcomes of our product for treating a grade 3 ulcer, the most severe type we aim to address, we have created the following comparative table.

No Treatment	Common Treatment	Our Treatment
Does not heal on its own	8-12 weeks on average	4-6 weeks
High likelihood of severe infection	Moderate risk of infections	Reduced risk of infections
20-25% risk of amputation	10-15% risk of amputation	Less than 5% risk of infection

In terms of availability and ease of use, the design of the patch will allow for mass production and distribution. This approach aims to democratize access to advanced wound treatments and reduce the global burden of diabetic complications on healthcare systems.

Discussion: The innovative methacrylated alginate hydrogel patch with microneedles offers significant promise for treating diabetic foot ulcers, particularly in DM-2 patients in Peru. Traditional treatments often face challenges such as poor drug absorption and rapid degradation, which our patch overcomes through its unique design and composition. The microneedles ensure localized and controlled release of tazarotene and mesenchymal cell-derived exosomes (MSCs), which are critical for promoting angiogenesis, reepithelization, and enhanced cellular migration. The use of pullulan-based microneedles ensures a cost-effective and efficient delivery system due to pullulan's biocompatibility and favorable mechanical properties. Preliminary results indicate a 45.1% release of tazarotene [4], significantly higher than conventional methods, which improves drug efficacy and minimizes side effects. Additionally, the hydrogel matrix provides a moist and protective environment, essential for optimal wound healing and infection prevention.

Conclusions: The Methacrylated alginate, chitosan nanoparticles and fucoidan microneedle patch, loaded with mesenchymal cell exosomes (MSCs) and tazarotene proves to be a promising and effective approach for the wound healing of

individuals with type 2 diabetes. This proposal provides evidence that the combination of controlled drug delivery and bioactive agents directly at the wound site can significantly accelerate the healing process. The expected outcomes include the patch's ability to promote angiogenesis, enhance cell migration, and sustain the release of therapeutic agents, which is essential for the effective treatment of chronic wounds associated with type 2 diabetes and to prevent reaching a stage of amputation in the patient

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Pressure-Relieving Dressings Infused with medicinal plant

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Introduction:

Pressure ulcers (PUs) are a prevalent problem in patients who remain in the same position for prolonged periods, due to friction and compression forces on the skin, impeding the flow of blood, nutrients, and oxygen, leading to tissue death. (Unidad de Enfermería INSNSB, 2021). They are common in patients in intensive care units (ICUs), general surgery, internal medicine, and obstetrics (Yovana F., Jesús R., Jenny J., 2020). During the COVID-19 pandemic, a study at Hospital Hipólito Unanue revealed a 54.5% (Marivel Rosa et al., 2022). PUs not only increase hospital costs and resources but also prolong hospital stays, underscoring the need for effective solutions (Unidad de Enfermería INSNSB, 2021).

Figure 1. Areas of the body prone to pressure ulcers (Unidad de Enfermería INSNSB, 2021)

Our product is intended to offer a comprehensive solution to heal and prevent the progression of PUs in their initial stages (stages I). The proposal is designed to be an initial response mechanism, present in any nursing or medicine cabinet environment, allowing its use by people with or without specialized knowledge in ulcer treatment. In order for the product to work effectively, the following aspects must be taken into account: possible allergic reactions to the hydrogel, adequate adherence to ensure the effects of the drug without causing injuries when it is

removed, versatility for its use in different parts of the body and a simple mechanism of use. By complying with the following aspects, the implementation of these dressings will significantly improve the quality of life of bedridden patients, reduce associated costs and optimize hospital resources and materials.

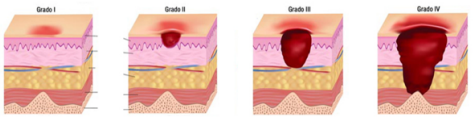

Figure 2. Classification for PUs (Dena, 2020)

Methods

We propose a dual approach: a primary hydrogel dressing effective in healing early-stage PUs through the release of natural drugs that promote skin regeneration and strengthening (Toscano & Cusme, 2023), and a secondary dressing that relieves pressure, protects the wound from infections and friction.

Table 1. Parts of the double dressing

Primary dressing It consists of a hydrogel, which has the ability to deform, hydrophilic, inert and high biocompatibility (Arredondo & Londoño, 2009). Its function will be to provide a moist environment for the wound, the absorption of exudate and the release of natural drugs. This type of dressing is ideal for early grade PUs (Bosch, 2004).
Secondary dressing It is made of silicone gel which will form a physical barrier against infection and relieve pressure

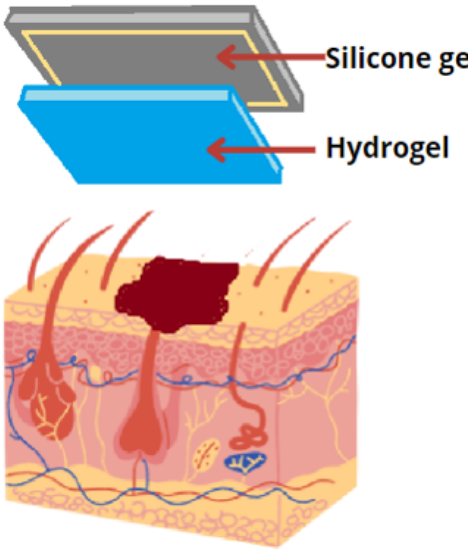

Figure 3. Primary and secondary dressing (own elaboration)

Results and Discussion

The comparison of medicinal plants grown in Peru reveals that *Uncaria tomentosa* (*Uña de gato*) and *Aloe vera* (*Sabila*) stand out notably for their anti-inflammatory and wound-healing properties. Uncaria tomentosa is particularly potent due to its oxindole alkaloids, which have therapeutic effects (Oscar Castro et al., 2021). Aloe vera, on the other hand, is known for its polysaccharides and essential vitamins that promote wound healing (Chang Liu et al., 2019). Equisetum arvense (*Cola de caballo*) is exceptional in providing structural support due to its high silica content. However, it has moderate anti-inflammatory and wound-healing properties and does not surpass the aforementioned plants. Meanwhile, Tomillo, with compounds such as thymol and carvacrol, stands out as a highly effective antibacterial agent; however, these compounds are hydrophobic, which limits their application (Aida Hajibonabi et al., 2023). The following table compares their properties and highlights the top performers according to their scores.

Table 2. Comparison chart between medicinal plants

Plant	Main composition	anti-inflammatory	Antibacterial	Structural	Healing	Total
Cola de caballo (*Equisetum arvense*)	Silica Flavonoids Alkaloids Potassium	3	3	5	3	14
Uña de gato (*Uncaria tomentosa*)	Pentacyclic and tetracyclic oxindolic alkaloids.	5	4	4	4	17
Tomillo (*Thymus vulgaris*)	Essential oils Thymol Carvacrol	4	5	3	3	15
Sábila (*Aloe vera*)	Polysaccharide Anthraquinones Vitamins	4	3	4	4	15

In the following table we compare the properties and characteristics that our product has and other alternative solutions that are used in pressure ulcer treatments in initial stages (INSNSB Nursing Unit, 2021). Due to the comprehensive approach of a double dressing, greater properties are achieved for the treatment of pressure ulcers and the prevention of their worsening

	Relieves pressure	medical properties				Exudate absorption	Hydration	debridement
		Anti-inflammatory	Anti-bacterial	Healing	Structural			
Double dressing (product)	X	X	X	X	X	X	-	-
Hyperoxygenated Fatty Acids	-	X	-	X	X	-	X	-
Hydrocolloid dressing	-	-	-	-	X	X	X	X
anti-decubitus mattresses	X	-	-	-	-	-	-	-

Conclusions: After analyzing the properties of native Peruvian plants, the anti-inflammatory, antibacterial, structural, and healing properties of Uncaria tomentosa and Aloe vera stand out. Compared to other products, these plants excel due to their medicinal properties, which are key features of the dressing, as well as their ability to absorb exudate. Additionally, the secondary structure of the dressing helps relieve pressure. However, it does not provide adequate hydration nor facilitate debridement. It is concluded that this dressing can contribute to the treatment of pressure ulcers in their early stages, as well as provide strengthening to the area before they develop. Moreover, the pressure relief will contribute to a more optimal and faster treatment for patients.

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Facial Mask for Motor Rehabilitation of Mouth Muscles to Improve Hypomimia and Speech in Parkinson's Disease Patients

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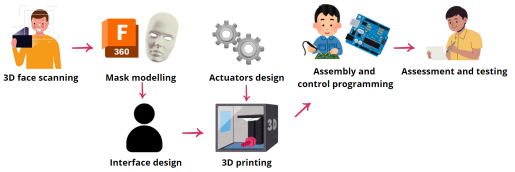

Graphical Abstract

Introduction: Parkinson's disease (PD) often causes stiffness in facial muscles, leading to hypomimia and impaired speech. This condition significantly impacts patients' communication and emotional expression. Traditional therapies and recent tools, such as acoustic and kinematic biofeedback, address these issues but do not directly focus on the physical rehabilitation of facial muscles and often require specialist intervention. Relevant projects in Peru, such as the Borjibot for neonates' oral-motor rehabilitation (Vela-Anton et al., 2020) and the pressotherapy mask for burn recovery (Tincopa et al., 2021), focus on physical rehabilitation using wearable technologies for therapeutic applications highlighting their potential and viability.

This project aims to prototype a facial mask that provides an automated platform for rehabilitating the primary mouth muscles through circular and vertical vibrating movements (Strojek et al., 2018) using soft actuators.

To achieve our primary objective, we will undertake 3D face scanning, mask design, printing, and assembly of soft actuators, focusing on the fabrication phase and leaving the possibility for future real-world testing.

Methods: To develop a facial mask for the rehabilitation of hypomimia and speech in PD patients, we will focus on 5 main mouth muscles (Fig. 2): the buccinator (aids in sound articulation and facial expression), the zygomaticus major and minor muscles (involved in lifting the corners of the lips, essential for smiling), the orbicularis oris (enables the pronunciation of labial sounds like "p", "b", and "m"), and the masseter (allows chewing and helps in facial expression). We initiate the fabrication with a 3D scanning process using an RGBD depth camera. This camera captures the geometry of the patient's face, providing a point cloud. These data is processed in Autodesk Fusion 360 to design a 3D model of the mask, ensuring it is customized for each patient. The mask is integrated with soft pneumatic actuators located at each muscle of the mouth. These actuators are made of synthetic silicone, capable of inflating and deflating with the air input, simulating a pneumatic chamber. Each actuator is connected to a controlled electric valve, allowing the adjustment of airflow, which is crucial to meet the patient's various needs. The system control is made by an open-loop in Arduino Mega, which activates the valves as indicated by the patient.

This user interaction with the system is by a simple interface with buttons that allow patients to start, stop, and adjust the intensity or speed of the therapy. A screen displays session times and relevant settings, ensuring ease of use. Safety is paramount, so voltage regulators are used to prevent damage to the devices and the patient. The mask is constructed using 3D printing technology, employing biocompatible materials that ensure comfort and durability for the patient. After assembly, initial prototype testing evaluates functionality and comfort, leading to adjustments based on feedback.

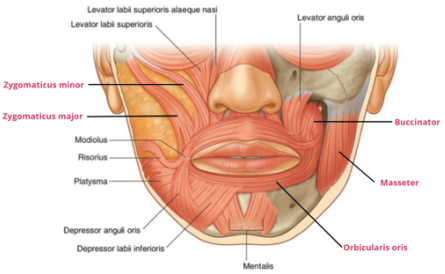

Figure 2. Anatomical positions of target mouth muscles (red)

Results and Discussion:

3D face scanning and mask design: Using the Shining 3D EinScan HX, a handheld 3D scanner known for its high-resolution capabilities and versatility, a detailed scan of the face was performed **(a, b)**. This device, which combines blue LED structured light and blue laser light sources, is ideal for capturing intricate details of various surfaces and textures. The resulting point cloud file **(c)** was then edited with MeshLab to isolate the area of interest necessary for mask design **(d)**. The edited point cloud was imported into Autodesk Fusion 360, using the scanned surface as a canvas to create profiles for an extrapolatable mask **(e)**. Advanced design

tools such as solid modeling, surface modeling were employed to adapt to the scanned surface and create precise forms and surfaces.

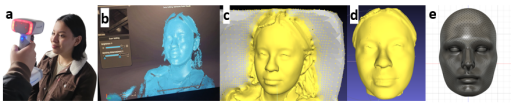

Figure 3. Mask design procedure

Design and assembly of soft actuators: The soft actuator **(a)** was designed with 3D CAD software along with its molds for silicone casting **(b, c)**. These actuators are capable of inflating and deflating (vertical movement) due to the pneumatic system. Additionally, they perform a circular movement thanks to a designed rotor **(d)** that works with a vibrating motor, which allows for a greater range of physical therapy. The assembled actuation system **(e)** is fabricated 5 times and they are placed in the correct anatomical position regarding the muscles to be rehabilitated.

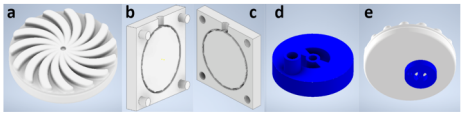

Figure 4. 3D model of the soft actuator system

Design of user interface (UI): Given the various needs of Parkinson's patients, a user interface (UI) has been designed to be simple and easy to operate (See Fig. 5). This UI allows the control of the speed of vertical and circular movements, and the force applied to each muscle, through physical buttons that are embossed for tactile function identification.

Figure 5. Proposed user interface

System Control Schematic: The system primarily consists of a user interface, a power MOSFET, a pneumatic pump, six mini electric valves, ten air chambers, and an Arduino Mega, chosen for its flexibility and capacity to handle multiple connected devices. This controller will regulate the air input to the pneumatic chambers by opening the electric valves based on the intensity and speed of movements selected by the user. Likewise, the MOSFET will ensure the input voltage is saturated to prevent damage to the actuators and the patient. Since no sensors are used for feedback, the control will be open-loop, allowing the user to have full control over the system parameters.

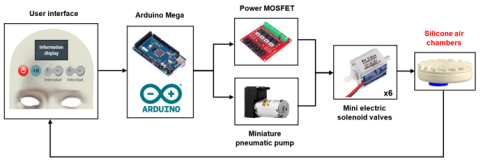

Figure 6. System Control Schematic

Conclusions:

In this work, we presented the pipeline for fabricating a novel facial mask aimed at the motor rehabilitation of mouth muscles through soft actuators performing circular and vertical vibrating movements. With this tool, we expect to significantly reduce the progression of hypomimia and impaired speech in PD patients, improving their quality of life regarding communication and emotional expression.

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Developing a user-friendly spanish Interface for Sigflow: Enhancing Leukemia Detection in Peruvian Children

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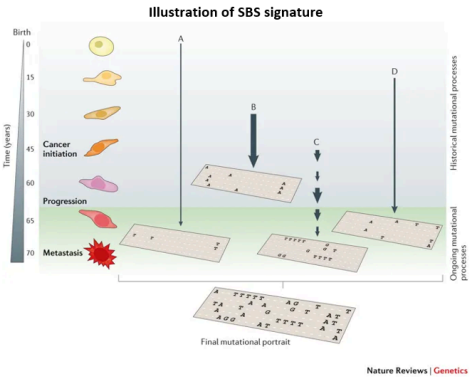

Fig 1. Source:https://www.nature.com/articles/nrg3729

Introduction: Leukemia is the most common cancer among children in Peru, with an average of 600 new diagnoses each year (2). One way to address this challenge is by improving cancer detection. In spanish-speaking regions linguistic barriers hinder the utilization of advanced genetic testing technologies.

The primary objectives of this study are:

Adapt Sigflow to include a user-friendly graphical interface in Spanish, replacing its current console-only format, to ensure accessibility for healthcare professionals.

Integrate the application and evaluate it's effectiveness in improving early leukemia detection and its impact on healthcare outcomes in Peruvian children.

Methods: The study will utilize the Django framework for developing the Spanish interface of the Sigflow application. Other tools include genetic testing datasets and software for data analysis such as R.

The aim is to collaborate with a laboratory that receives patient samples and conducts genetic analysis, specifically one that tests children. We intend to trial the software, compare it with their previous methods, and evaluate its effectiveness

Fig 2. Source:https://github.com/ShixiangWang/sigflow

Mutational signatures are repetitive DNA alteration patterns resulting from distinct mutational events throughout the evolution of cancer. Sigflow can process patient cancer data to extract these mutational signatures, fit the data to reference signatures, and perform stability analysis. It generates images and data outputs that enable experts to determine if a person has cancer by analyzing the mutational patterns, thus aiding in accurate and early cancer detection

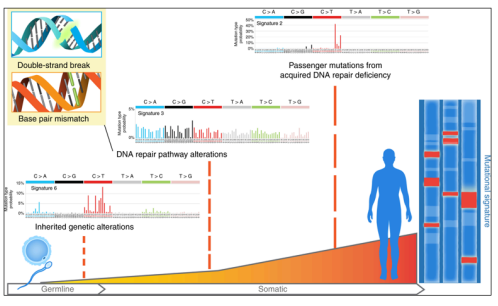

Fig 3. Source:https://www.nature.com/articles/s41467-018-05228-y

Figure 1 delineates the progression of cancer from birth through metastasis, emphasizing the accumulation of single base substitutions

(SBS) over time as a result of both historical and ongoing mutational processes. It visually represents the various stages of cancer development, highlighting specific mutational events (labeled A, B, C, D) that collectively form the final mutational portrait observed in cancer genomes. This figure enhances the understanding of how cumulative genetic alterations drive cancer development.

Figure 3 illustrates the origins of SBS signatures, encompassing both inherited genetic alterations and mutations acquired due to DNA repair deficiencies. The figure demonstrates how double-strand breaks and base pair mismatches contribute to specific mutational signatures, with graphs depicting the prevalence of different mutation types (e.g., C>A, C>G). The right side of the figure showcases the distribution of these mutations across the genome, offering a comprehensive view of the mutational landscape in cancer.

Conclusions: Enhancing cancer detection technologies is crucial to address the high incidence of childhood leukemia in Peru. This project adapts Sigflow with a Spanish graphical interface and integrates it into clinical workflows to overcome linguistic barriers and improve early detection. Using Django, genetic testing datasets, and analytical software, we will collaborate with a pediatric genetic testing lab to trial and compare the application's effectiveness. Sigflow's ability to process mutational signatures and provide detailed analyses will facilitate accurate early cancer detection, ultimately improving healthcare outcomes for Peruvian children.

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Design of an exosuit for lumbar erector spinae stiffness' measurement in adolescent patients with lumbar idiopathic scoliosis as a non-invasive monitoring method

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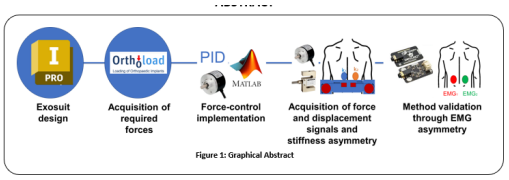

Introduction: Scoliosis is a lateral deformation on the spine. It can severely affect mobility, respiratory functions and self-perception if untreated. Its standard of care is a combination of physiotherapy sessions and monitoring of the scoliotic curve's angle through periodic X-rays sessions [1]. However, X-rays can have a negative impact on human health with the potential of damaging cells through ionizing radiation. Moreover, X-rays sessions are scheduled at least twice a year which makes it necessary to avoid as much x-ray exposure as possible. While X-rays are useful for tracking changes in the spine's curvature, they don't help tracking other important aspects like muscle strength and stiffness. The latter is important to measure since scoliosis impacts on stiffness by making one side of the back stiffer than the other and its asymmetry worsens when progressing. Therefore, a new non-invasive monitoring method for measuring muscle stiffness is proposed, particularly for teenagers, who are more likely to experience worsening scoliosis.

Non-invasive methods for monitoring scoliosis, such as measuring trunk posture [2] and using 3D imaging [3], only allow the detection of curve-related deviations providing similar

results to X-rays. Recent efforts in tracking biomechanically-related parameters have been made with EMG signals [4] and stiffness data [5]. However, only one device [5] integrated these methods, and it resulted in a bulky and expensive prototype. The goal of this research is to create a low-cost, comfortable exosuit (soft exoskeleton) to monitor stiffness in the lower back muscles. To achieve this, the exosuit will be modelled and fabricated, desired cable forces will be calculated, and the mechanism will be programmed and implemented. After determining muscle stiffness data, EMG signals from the same muscles are used to evaluate the reliability of this new monitoring method.

Methods: The neoprene-based exosuit is composed of 2 DC Motors with high torque and integrated encoders, bicycle brake cables which act as Bowden (force-transmission) cables, L298N motor drivers, DYLY-106 load cells, Arduino Mega and a 12V power source (Figure 2).

Stiffness is obtained through the use of Hooke's Law (F=k*x where F: applied force, k: material stiffness and x: resulted displacement). Hooke's Law can be applied in muscles under certain considerations [6]. In the exosuit, force and displacement values are obtained through load cells and rotary encoders respectively.

Stiffness asymmetry is obtained through the mechanism application on the left and right lumbar erector spinae muscles of an adolescent with scoliosis. As a way of validating its reliability, EMG signals are obtained on these muscles to see the muscle tone asymmetry of the same person.

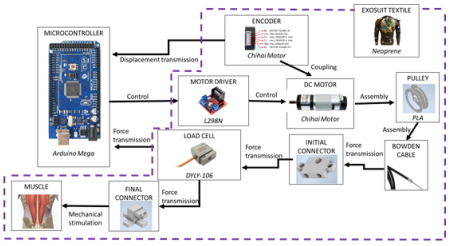

Figure 2. Schematic of the exosuit system

Results and discussion: The exosuit components are 3D-printed with PLA (orange/blue) and TPU (gray) for its rigid and flexible parts respectively (Figure 3). Then, the setpoint forces are obtained by the Orthoload database. Scoliosis-related physiotherapy postures were selected within the Orthoload database and average forces exerted on lumbar muscles during these specific movements were calculated. The calculated forces were 21.5N, 10.5N and 45N

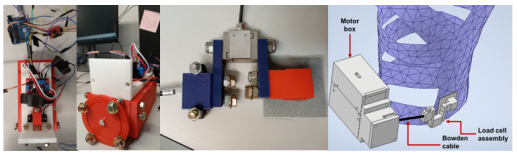

Figure 3. (a) Motor box [top] (b) Motor box [front] (c) Load Cell assembled with Bowden cable (d) Components placement on exosuit

The calculated forces are transmitted from the motor, through a pulley system, to the cable that interact with the lumbar erector spinae muscles. The cable tension is controlled using a PID (Proportional-Integral-Derivative) system, which ensures the motor maintains a constant speed. When the motor runs at a speed of 4 rpm, the pulley adjusts the cables to the desired tension (as shown in Table 1) and stops.

Desired force (N)	Sensed force (N)	Error (%)	Force drop (N)
21.5	21.23	1.26	4.73
10.5	6.83	34.95	9.89
45	42	6.67	9.06

Table 1. Controlled exosuit cable forces

The force error, which is the difference between the actual and desired force on the cables, is quite low, demonstrating the accuracy of the system's control. Additionally, the force drop (the decrease in force from when the motor stops until the measurement is completed) is less than 10N. This indicates that the force remains fairly stable, which is beneficial for accurate calculations.

After measuring the force and displacement values in a static setup, EMG signals were obtained from a 14-year-old patient with mild lumbar scoliosis. The asymmetry coefficients of these EMG signals were then calculated while the patient performed specific physiotherapy postures (Table 2).

Posture	Contraction	L-EMG amplitude	R-EMG amplitude	Asymmetry (%)
1	1	1.2023	1.2329	2.48
	2	1.2334	1.2349	0.12
	3	1.2023	1.2368	2.79
2	1	0.2737	0.5811	52.90
	2	0.2646	0.3558	25.62
	3	0.2353	0.5684	58.60
3	1	0.2966	1.2212	75.71
	2	0.4584	1.2247	62.57
	3	0.4136	1.2247	66.23

Table 2. EMG values obtained on a scoliosis patient

The EMG asymmetry varies in different postures because muscles contract differently depending on the circumstances. Consequently, it is expected that stiffness asymmetry will also vary with the different forces applied. Additionally, the EMG amplitude is greater on the right side of the muscle, which is the concave side of the patient's scoliotic curve. This finding aligns with similar research on the lumbar region [4].

The system is scheduled to be implemented with this patient in the upcoming weeks, and stiffness asymmetry will be calculated. It is anticipated that the stiffness results will strongly correlate with the EMG values, thereby validating the reliability of the monitoring method.

Conclusions

An exosuit was designed for the measurement of the lumbar erector spinae's stiffness asymmetry. An accurate force control system was implemented for cable tension on the exosuit. This tension is applied to the muscle and measured by a load cell while its displacement is measured by an encoder, both are used for stiffness calculus through Hooke's Law. The EMG results (proven method [4]) will be contrasted with the stiffness asymmetry results (proposed method) in the short-term experiments. Such correlation would not only validate the reliability of the proposed exosuit method but also lay the groundwork for a novel, non-invasive, and cost-effective approach to monitoring scoliosis.

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Design of a low-cost portable hemodialysis device prototype for its implementation in Peru

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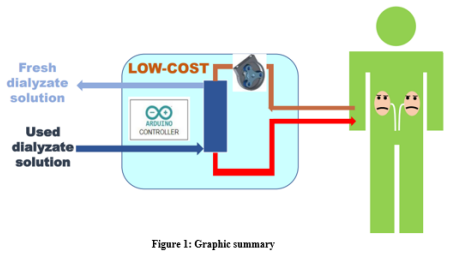

Figure 1: Graphic summary

Introduction: Chronic Kidney Disease (CKD) ranks fifth in Peru's leading causes of death, with a 4.3% increase since 2011 (Institute for Health Metrics and Evaluation, 2017). This

situation has led to a severe crisis in hemodialysis services, exacerbated by a lack of dialysis centers and a shortage of nephrologists. The Ministry of Health (Loza et al., 2015) reported an urgent need for services for end-stage patients, facing a very limited supply. In Peru, there are only 356 registered nephrologists for about 3 million people over 18 years old with CKD, of whom 88% depend on hemodialysis as a terminal renal replacement therapy.

On the other hand, recent studies (Balarezo et al., 2021; Ferguson, 2021) have indicated that home hemodialysis (HHD) provides economic, clinical, social benefits, and improves the quality of life of patients. That is why we aim to design a low-cost portable hemodialysis device prototype for its implementation in Peru, focusing on reducing manufacturing costs and replicating the processes performed by traditional hemodialysis machines.

Methods: The hemodialysis prototype employs an Arduino Uno microcontroller for data acquisition and control. Equipped with temperature, pressure, flow sensors, and an ultrasonic air bubble sensor to monitor crucial parameters. The Arduino regulates the peristaltic pump to control solution flow, while a heated bed maintains optimal temperature. Data collected is transmitted to LabVIEW for real-time analysis, ensuring system efficacy. In addition, the prototype consists of: an arterial and venous line set, a dialyzing filter, purified water and a dialysis liquid concentrate.

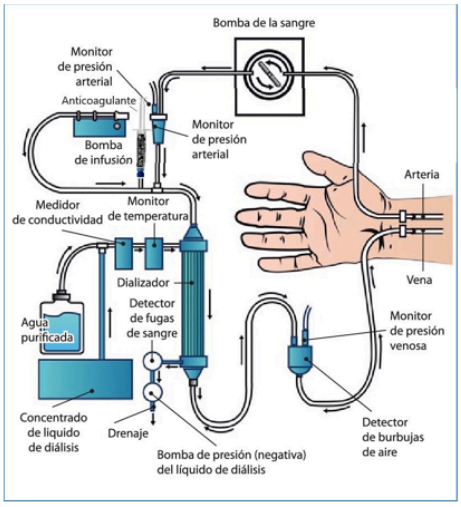

Figure 2. Design. Source: CTO Editorial

Results and Discussion: Our target audience are patients insured under EsSalud (Social security health insurance), as it is the IAFA (Peru's Health Insurance Fund Administration Institutions) with the highest percentage of patients in replacement therapies (Loza, 2015). Given this target group, HHD offers numerous advantages for them:

Economic: HHD reduces hospitalization days by 16% due to better volume control and electrolyte management, leading to significant savings (Zimbudzi & Samlero, 2014). It saves time and money by reducing travel for dialysis (Vidau, Rodríguez & Díaz, 2018). It also saves up to 42% on antihypertensive medications with improved blood pressure control (Kraus et al., 2007). Additionally, it offers flexibility for patients to maintain their employment (Walker, 2018).

Clinical: HHD improves survival rates (Krahn et al., 2019) and reduces the need for medications for anemia, mineral bone management, and hypertension. More frequent dialysis sessions help lower emergency hospitalizations (Ferguson, 2021).

Social: HHD enhances quality of life and patient satisfaction, eliminates waiting times, and offers flexible scheduling (Ferguson, 2021).

Table 1. Economic benefits por payors

Country	HHD Cost per Patient/Year	Conventional HD Cost per Patient/Year	Source
Australia	$33 392	$36 284	(Li et al.,2018)
UK	$38 142	$44 729	(Ferguson, 2021)
Japan	$43 044	$48 324	(Kawanishi et al., 2017)

Our portable hemodialysis design was based on a careful adaptation of the operating principles of conventional hemodialysis machines, prioritizing simplicity, efficiency and accessibility. We worked on the study of each stage of the hemodialysis process in order to bring it to a scale that can facilitate its portability, from blood intake to its return to the patient, simplifying pumping and filtration systems. Our choice of materials was guided by local availability and economic feasibility, ensuring that our device could be produced on a large scale and at an affordable cost. The

production cost of our prototype was about $900, being lower than the prices at which hemodialysis devices is sold. Although we were in the early stages of development and optimization, we were committed to extensive testing to ensure the safety and efficacy of the device before deploying it in communities with unmet medical needs.

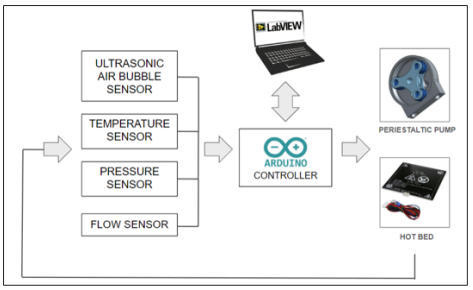

Figure 3. Configurations of the control system.

Conclusions: We conclude that it is possible to design and develop a low-cost and portable hemodialysis device. According to our preliminary work, which is presented in this poster, the production cost would be much lower than those of conventional devices. Our solution could help not only mitigate the urgent need of these devices for end-stage patients with CKD in Peru but also improve their quality of life.

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Design and Characterization of a Film Based on Collagen Obtained from Anchoveta and Bioactives from Aloe Vera for the Regeneration of Diabetic Ulcers

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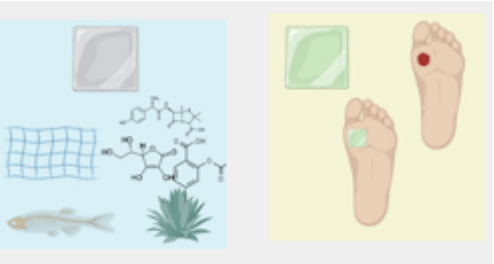
Introduction: In 2014, 285 million people with diabetes were registered in the world, and this figure is expected to increase to 438

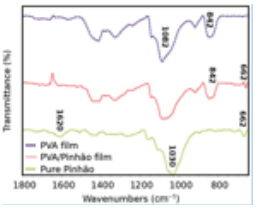
million by 2030 [1][2]. Diabetes mellitus is a disease that commonly produces ulcers in the foot which can cause loss of functionality of the feet. Due to this, it is necessary to develop methods to prevent this wound from evolving into gangrene and, in extreme cases, having to amputate the limb. In this context, hydrogel-based dressings have emerged as a promising option for the treatment of diabetic ulcers, offering hydration and protection properties and facilitating the wound healing process.

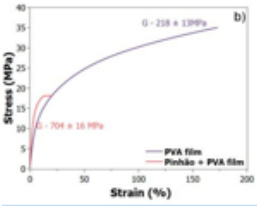
An hydrogel film based on collagen from residual (thorns, spines and scales) anchovy along with aloe vera is proposed as an effective and non-invasive solution, with the aim of improving the quality of life of patients and reducing the need for further aggresive interventions such as amputation.



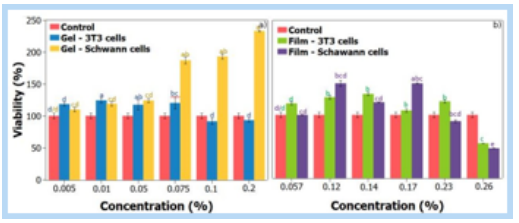
Expected Results [3]

The FTIR test should show a decrease in the peaks of the aloe bioactive components, indicating the release of bioactives from the film, and verify the absence of contaminants by ensuring there are no additional peaks that are not from collagen or aloe bioactives. For the tensile test should demonstrate high tensile strength to ensure the film does not break easily when handled or adhered to the skin. Respect the degradation test, we expect a controlled degradation rate that aligns with the healing time of the ulcer.



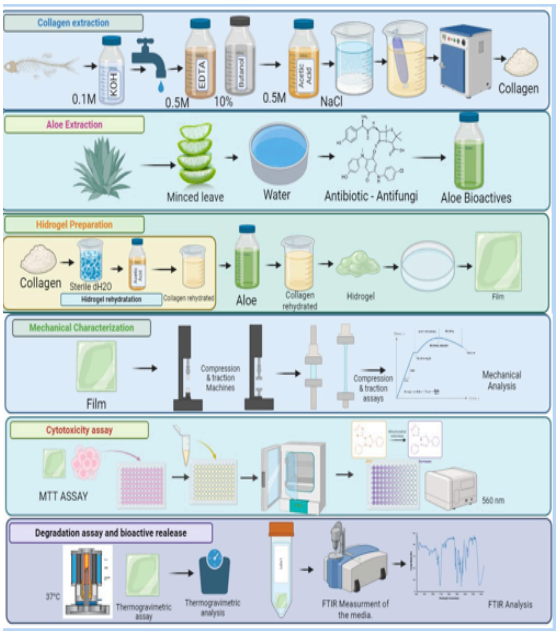


The cytotoxicity test is crucial for evaluating the safety of the film that will be in contact with the skin. We expect that the cells in contact with the film will maintain high viability after the incubation period, indicating that the film is not toxic to the cells and allows for normal proliferation, ensuring it does not inhibit cell growth.



Objective: To design and characterize an hydrogel based on collagen obtained from anchovy and aloe vera bioactives to regenerate diabetic ulcers. This ensures a low-cost and sustainable product by utilizing natural and inexpensive resources.

Methods: For the development of this film we must follow the mentioned methodoloy that consist in:



First the collagen is extracted from anchovet using tensoactives and a precipitating agent, then the bioactive compounds from alloe are obtained by soaking pieces of the lead on water, finally the hydrogel is developed using a crros linking agent. For the characterization of the film, tension testing and citotoxicity assays with epithelial cells were made

Conclusion: This research makes a significant contribution to the field of wound care by offering a sustainable and effective solution for diabetic ulcer management. This innovative approach has the potential to transform diabetic ulcer management, offering a safer and more effective treatment option. Future research could focus on adding drugs such as analgesics, antifungals, and antibacterial agents to the hydrogel film to further enhance its functionality and therapeutic efficacy.

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Deep learning for detecting spina bifida in fetal ultrasounds

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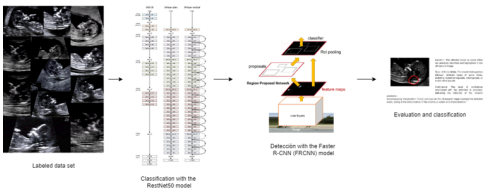

Figura 1: Graphical abstract

Introduction: According to the MINSA (Ministry of Health), 15 out of every 10,000 children in Peru suffer from spina bifida at birth each year. Although there are postpartum treatments to correct this malformation and counteract its effects, it is possible to further improve the quality of life of the baby through an intervention before birth.

The diagnosis of this disease is made between weeks 11 and 14 of pregnancy through an ultrasound. However, in many cases it is difficult to determine the presence of this malformation during this period. Therefore, it

is necessary to wait until the second trimester, between weeks 18 and 22.

Our project aims to reduce this waiting period, offering a much earlier and more precise diagnosis in order to provide early treatment. By using predictive models, we have been able to create a system capable of detecting the disease between weeks 11 and 14. The machine learning model we have trained uses Deep Learning techniques and aims to become an essential support for doctors in their work. This tool improves the detection and diagnosis of Spina Bifida in fetuses (Mora P. 2022).

Methods

Data Collection

Dataset: Ultrasound images were collected from various medical centers, including both normal and spina bifida cases.

Preprocessing: Images were resized to 224x224 pixels and normalized.

Model Architecture

Pre-trained Model: ResNet50, pre-trained on ImageNet.

Transfer Learning: Transfer learning was applied using the pre-trained weights of ResNet50 and fine-tuning the model on our ultrasound dataset.

Faster R-CNN (FRCNN) Integration

Detection Model: Faster R-CNN was implemented for the precise detection of areas affected by spina bifida within the images.

Training Procedure

Loss Function: Binary cross-entropy for classification and specific detection loss function for FRCNN.

Optimizer: Adam.

Metrics: Accuracy, precision, recall, and F1-score.

Training/Validation Split: 80% training, 20% validation.

Implementation

Software: TensorFlow/Keras for ResNet50 and a compatible framework for Faster R-CNN.

Hardware: NVIDIA GPU for accelerated training and detection process.

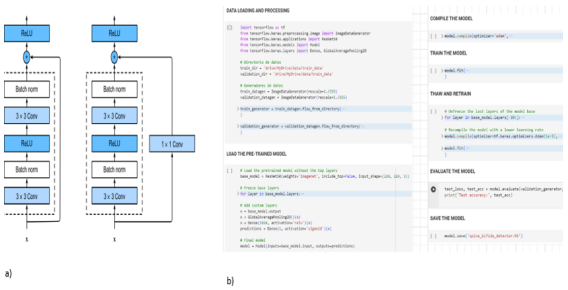

Figure 2. (a) Model design (b) Model prototype

Results and Discussion: The pretrained models ResNet50 and Faster R-CNN (FRCNN), when processing the ultrasounds, produce predictions with a high percentage of accuracy and reliability. These models provide a detailed analysis, including the location of the affected areas in the spinal cord and the type of spina bifida the fetus likely has. According to Schindelmann (2021), spina bifida is systematically classified into spina bifida occulta and three subtypes of open spina bifida: meningocele, myelomeningocele, and myeloschisis.

The classification of the ultrasounds is based on the presence or absence of spina bifida. If spina bifida is present, the results are further categorized according to the identified type. These results are supported by rigorous performance metrics, which reinforce confidence in the model's accuracy and reliability

Tabla 1. Conditions of operations

Metrics	Values
Accuracy	95%
Precision	93%
Recall	92%
F1 Score	92.5%

The obtained results highlight the significant advantages of the trained models ResNet50 and Faster R-CNN compared to other approaches. The strength of ResNet50 lies in its deep architecture, the use of residual blocks, and the application of transfer learning, enabling it to learn complex features and generalize

effectively. On the other hand, according to Girshick(2015), Faster R-CNN is distinguished by its improvement in the speed of training and testing and at the same time increasing the detection accuracy of locating different objects to identify specific anatomical structures. This hybrid approach significantly improves performance metrics, minimizing both false positives and false negatives, and ensures more accurate and reliable diagnoses.

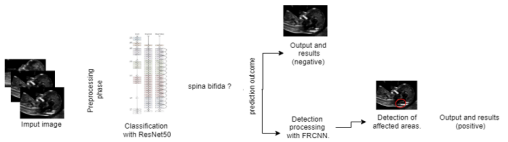

Figure 3. Model process architecture

These results not only underscore the viability of using deep learning models for the detection of spina bifida from ultrasound images, but also highlight the potential of this technology to significantly improve diagnostic outcomes and patient care. As suggested by Mora (2022), prediction techniques using machine learning increasingly provide support tools for risk management decision-making and early warning alerts, further emphasizing the importance of deep learning models in the medical field.

Conclusions: A model for early detection of spina bifida in fetuses has been developed using deep learning techniques. This system processes fetal ultrasound images with ResNet50 and Faster R-CNN, improving the accuracy in detecting and locating the anomaly. This advancement provides peruvian doctors with a valuable tool to enhance prenatal medical intervention.

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BOVI-TEC: A Low-Cost Nutritional Supplement for Malnutrition Relief

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Introduction: Peru faces a public health crisis characterized by a "triple burden of malnutrition," which includes child malnutrition, anemia, and issues of overweight and obesity. In 2022, the National Institute of Statistics and Informatics (INEI) reported that 42.4% of children aged 6 to 35 months suffered from anemia, while 11.7% and 9.1% of children under 5 years old experienced chronic malnutrition and overweight or obesity,

respectively. This alarming situation reflects not only a lack of nutritious food but also a predisposition to non-communicable chronic diseases such as diabetes, cardiovascular diseases, and cancer, according to the WHO. This research aims to design a nutritional supplement that complements essential nutrients in low-nutritional-value diets and is economically accessible.

Objtives:

General

Design a low-cost product that provides essential nutrients to the diet of malnourished individuals.

Specific

1. Implement natural nutrient compounds that address both malnutrition and anemia, ensuring they meet minimum nutritional standards.
2. Develop an inexpensive and easy-to-manufacture packaging for the product.
3. Create an affordable and natural product that is safe for both human health and the environment.
4. Analyze the product's viability, including cost analysis and target population assessment, to create an innovative and appealing product.

Ensure the production process is scalable to accommodate increased demand, maintaining quality and cost-effectiveness while adhering to sustainable practices.

Key Ingredients For Protein And Nutrient-Rich Supplement.

Bovine Colostrum

Bovine colostrum is the first secretion of the mammary gland obtained within the first 48-72 hours postpartum. It contains the same components as raw milk but also includes several immunological agents, higher fat content, proteins, peptides, vitamins, and minerals (Vivas, J., 2021). A calf requires an intake equivalent to 8.5-10% of its body weight, which for a 40 kg calf means consuming 3.5-4 liters of colostrum twice. The mother produces an average of 2 to 6 liters of colostrum daily until the third day postpartum. Therefore, about 55% of the colostrum is not utilized and is considered waste since the calf no longer needs it (Mendoza et al., 2017). This colostrum, rich in nutrients and immune-boosting properties, forms a vital part of our supplement.

“Sangrecita” (Dried Bovine Blood)

“Sangrecita” or dried bovine blood is an exceptionally protein-rich ingredient, containing 83.7 grams of protein per 100 grams, and a significant level of iron, with 385.2 mg per 100 grams (Galarza, 2011). This high protein and iron content make it an essential component of our supplement, contributing to the formation of hemoglobin and the efficient transport of oxygen in the body. By incorporating “sangrecita,” we enhance the overall nutritional value, providing vital nutrients necessary for a balanced diet.

Animal Collagen

Collagen is a valuable protein with applications in the food, pharmaceutical and cosmetic industries. The abundance of collagen in fish skin, chicken legs and wings is due to the structural and support functions this protein plays in the animals' bodies. Taking advantage of the collagen in these parts not only has economic and nutritional benefits, but also helps reduce waste in the fishing and poultry industries (Mizuta et al, 1994). Currently in Peru, approximately 90 tons of by-products such as fish skin, bones, fins, head and backbone are wasted, while in the case of chicken, these parts are sold at a very low price.

Materials and Methodology

Ingredients

Nutritive Paste

- 400 ml of bovine colostrum
- 325 g of chicken or pork feet

- 3 tablespoons of agar powder
- 100 g of "sangrecita" (dried bovine blood)
- 1 peach (optional, for additional flavor and vitamins)
- Water
- White vinegar

Wrapper

- 30 ml of animal gelatin (preferably porcine)
- 600 ml of water
- 5 ml of honey
- Small sheet of paper (for molding the wrapper)

Materials

- Medium pot
- Large pot
- Flexible silicone mold
- Flat flexible mold (approx. 30 x 60 cm)

Figure 1. Preparation of BOVI-TEC.

The scalability of this nutritional supplement is rooted in the accessibility and low cost of its primary ingredients, such as bovine colostrum and "sangrecita," which are often considered by-products in the dairy and meat industries. Utilizing these readily available resources minimizes production costs and ensures a steady supply chain, making large-scale production feasible. Additionally, the simple processing techniques for extracting collagen and incorporating agar as a gelling agent allow for easy adaptation to larger production volumes without requiring significant changes to the existing infrastructure.

Future steps: Liposomes are spherical vesicles formed by one or more lipid bilayers, similar to cell membranes. The use of liposomes in the food industry presents a number of significant advantages that can improve the quality, stability and efficacy of food products. Encapsulation of nutrients, antioxidants and other bioactive compounds in liposomes not only protects these ingredients from degradation, but also improves their bioavailability and allows for controlled release, thus contributing to healthier and higher quality products.

Conclusions:

The BOVI-TEC project has successfully developed an innovative and affordable nutritional supplement, specifically designed to address malnutrition in vulnerable populations. By utilizing natural ingredients such as bovine colostrum and dried bovine blood, along with a scalable production process and cost-effective packaging, we have created a product that not only provides essential nutrients to combat malnutrition and anemia but is also safe for human health and the environment. The conclusions of this project underscore the importance of innovation in nutrition and the need for accessible and sustainable solutions to improve the health of marginalized communities.

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