Proceedings from the 2024 Symposium on Science, Technology and Health

Edited by Marissa Barrera, Sofia Binioris, Rana Khan, and Amiya Waldman-Levi

Katz School of Science and Health
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Katz
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Foreword

The 28 extended abstracts published in these proceedings—originally presented at the Katz School's 2024 Symposium on Science, Technology and Health—offer a glimpse into the exciting work that Katz School graduate students are doing to advance scholarly knowledge, shape industry and transform lives.

The 2024 symposium was held in New York City on May 9, 2024, and was organized by the symposium scientific committee, including:

- Marissa Barrera, Ph.D., MSCS, CCC-SLP, Assistant Dean of Health Sciences and Director, M.S. in Speech-Language Pathology
- Sofia Binioris, M.A., Executive Director, Brand Communications and Strategy
- Rana Khan, Ph.D., Clinical Professor and Founding Director, M.S. in Biotechnology Management and Entrepreneurship
- Amiya Waldman-Levi, Ph.D., OTR/L, FAOTA, Clinical Associate Professor and Director of Scholarship and Research of Occupational Therapy

Projects featured at the symposium spanned the school's graduate programs in Artificial Intelligence; Biotechnology Management and Entrepreneurship; Cybersecurity; Data Analytics and Visualization; Digital Marketing and Media; Mathematics; Occupational Therapy; Physician Assistant Studies; Physics; and Speech-Language Pathology.

Four projects were recognized for their exceptional scholarship:

- **Outstanding Scholarship in STEM:** M.S. in Artificial Intelligence students Radek Holik, Ruslan Gokan and Manish Kumar Thota for their work on a machine-learning chatbot that can assist students academically by acting as a digital brain.
- **Outstanding Scholarship in Health:** Occupational Therapy Doctorate students Jessica Kwok and Rachel Hirsch for their study on a healthy aging program to improve older adults' sense of hope and well-being.
- **Overall Impact in STEM:** M.S. in Data Analytics and Visualization students Gagan Preet Singh and Karina Thapa for their work on Zeomancer, an intelligent weather station that collects environmental data to help Tanzanian farmers improve crop yield.
- **Overall Impact in Health:** M.S. in Physician Assistant Studies student Simone Northman for her research on treatment options for pregnant women with preeclampsia.

Symposium attendees also voted to give Alaa Etouni, M.S. in Physician Assistant Studies, the "People's Choice" award for her research on treatment for anemia patients with active helicobacter pylori infections.

The students, whose projects are works-in-progress, were mentored by Katz School and Yeshiva University faculty, as well as researchers and industry and community partners from Afya Foundation, Albert Einstein College of Medicine, Basura, Colorado State University, Dance Project of Washington Heights, Growmics, Heights Meditation & Yoga, Mercy University and Renal Research Institute. The scientific committee would also like to acknowledge David DeFusco, Denton Field, Ann Leary, Grace Morrison, Rafael Reyes and John Vivolo, as well as our graduate student volunteers for their invaluable contributions.

Contents

Message from the Dean

At the Katz School, we are research scientists, tech builders and patient-centered clinicians working on problems that matter. We take an interdisciplinary approach to research and education, fostering the creativity, collaborative thinking and builder mindset required to take on today's toughest problems. In the lab, classroom and clinic, we lead with integrity, generosity and a commitment to making the world smarter, safer and healthier.

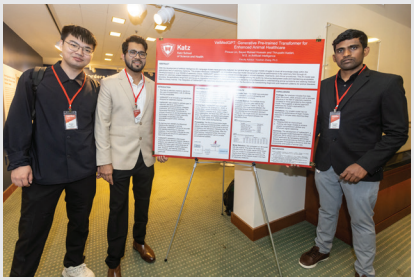
The projects on display at the 2024 symposium—drawn from every one of the Katz School's STEM and Health Sciences graduate programs—exemplify our students' fulfillment of this mission

Sincerely,

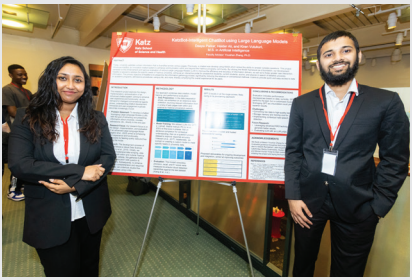
Paul Russo
Paul Russo, Ph.D.
Dean, Katz School of Science and Health
Vice Provost, Yeshiva University
Professor of Data Science and Information Systems

Artificial Intelligence

Left to right:
Youshan Zhang, Saratsuhas Vijayababu, Sheng-Han Yueh, Shengjie Zhao, Radek Holik, Yujie Wu, Kiran Vutukuri, Ruslan Gokhman, Thirupathi Kadari, Manish Kumar Thota



Pinxue Lin, Sayed Raheel Hussain and Thirupathi Kadari



Deepa Paikar and Haider Ali

KatzBot: An Intelligent Chatbot Powered by Large Language Models

Haider Ali, Sahil Kumar, Deepa Paikar and Kiran Vutukuri
M.S. in Artificial Intelligence

Faculty Mentor
Youshan Zhang, Ph.D., Assistant Professor, Artificial Intelligence and Computer Science

Introduction

Effective communication within university communities is vital for meeting the diverse needs of stakeholders, such as students, alumni and information consumers. Existing academic chatbot systems often lack precision, necessitating improved solutions. In this study, we introduce KatzBot, a novel chatbot system powered by Katz Generative Pre-trained Transformer (KatzGPT), a custom Large Language Model (LLM) designed to address these precision gaps. This innovative system represents a major advancement in academic chatbot technology.

Method

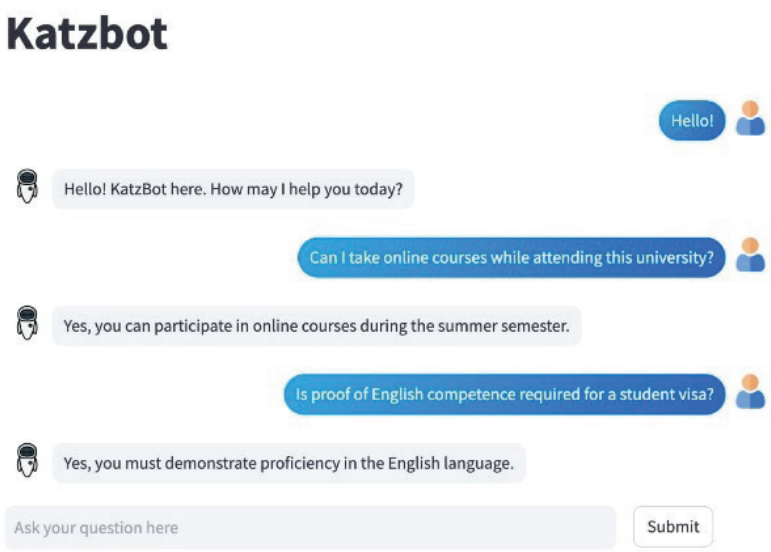
We curated datasets with 6,280 sentence-completion pairs and 7,330 question-answer pairs. The model is initially trained on sentence-completion pairs to build its knowledge base and then fine-tuned on question-answer pairs to enhance response accuracy. The dataset comprises question-answer pairs from academic contexts, including university-related inquiries and responses. Each data item consists of a question and its corresponding answer. The data is tokenized using the AutoTokenizer from the Hugging Face library, which encodes each question-answer text into token indices, ensuring compatibility with the model architecture. This dataset prepares

input-output pairs for training the CLM, with each data item including input token IDs and corresponding label token IDs, representing the next token prediction.

KatzBot features an intuitive interface that facilitates seamless communication between users and the model, significantly improving user experience and satisfaction (Figure 1).

Figure 1

Katzbot Interface



Results

The KatzGPT model outperforms current SOTA models in knowledge enrichment and response precision. In our comparative analysis, we benchmark the performance of SOTA Large Language Models (LLMs) using Rouge Scores, focusing on Rouge-L to assess long-form text coherence (Table 1).

Table 1

KatzGPT Performance vs. Other Prominent Models

Model	Rouge-1	Rouge-2	Rouge-L
Llama2 3B	0.23	0.07	0.20
Microsoft Phi 1.5	0.26	0.10	0.24
Llama2 7B	0.28	0.12	0.25
Microsoft Phi2	0.34	0.15	0.31
Mistral 7B Instruct	0.43	0.20	0.33
GPT-2	0.45	0.32	0.43
LlamaMOE	0.49	0.36	0.47
KatzGPT	**0.53**	**0.43**	**0.51**

KatzGPT, leveraging GPT architecture, excels in Rouge-L, outperforming advanced models like Llama2 7B, Microsoft's Phi 1.5, and GPT-2, indicating its robust capability in understanding and reproducing context and structure. While GPT-2 remains strong, KatzGPT surpasses it in coherence and contextual understanding. Mistral 7B Instruct, though leading in task-specific performance, trails in Rouge-L. Llama2 models show incremental improvements with scaling but still lag advanced systems. Microsoft's Phi 1.5 and Phi2 demonstrate substantial performance increases with Phi2 showing significant enhancements. Despite their strengths, Mistral 7B Instruct and Llama2 models fall short of KatzGPT's performance. KatzGPT's superior scores across all Rouge metrics establish it as a leading model in the LLM landscape, confirming its robust capability in maintaining coherence over extended texts and its status as a formidable competitor amidst the rapid evolution in the field.

Conclusions and Recommendations

KatzGPT's advanced capabilities in text comprehension and response generation, marking a significant milestone in LLM evolution. While GPT-2 once epitomized excellence, KatzGPT's superior results redefine what is achievable, signaling a promising direction for future AI research and development. The potential for KatzGPT to achieve even greater performance with further training and enhancements is promising and indicative of its future impact on the field:

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SparrowVQE: Harnessing Computer Vision and Language Processing for Enhanced Visual Question Explanation in Education

Ruslan Gokhman, Radek Holik and Manish Kumar Thota
M.S. in Artificial Intelligence

Faculty Mentor
Youshan Zhang, Ph.D., Assistant Professor, Artificial Intelligence and Computer Science

Introduction

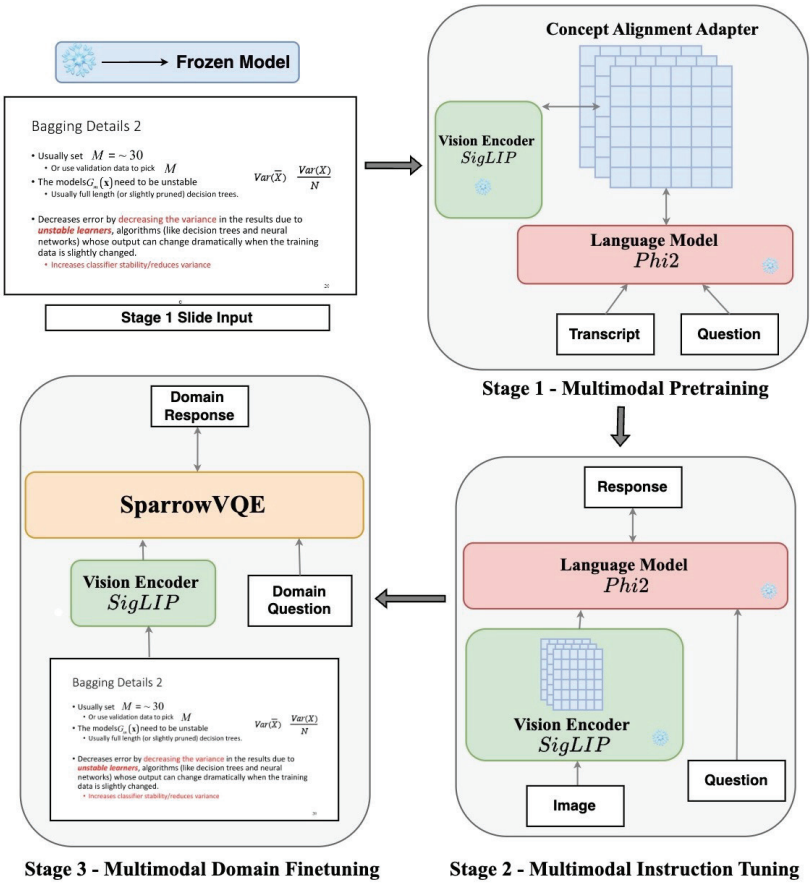
Our paper addresses the inherent limitations of existing Visual Question Answering (VQA) systems within educational contexts, particularly in the domain of machine learning lectures, where intricate visuals and text abound (Barra et al., 2021, Malinowski et al., 2014). While traditional educational resources often fail to provide the engagement and context-aware assistance necessary for effective learning (Norcliffe-Brown et al., 2018), recent advancements in VQA systems present promising avenues for enriching the educational experience (Radford et al., 2021). Drawing insights from the evolution of VQA, including its applications in medical and educational fields, and the development of sophisticated fusion-based and attention-based methods (Chen et al., 2020), we propose SparrowVQE, a novel approach tailored specifically for machine learning lectures. SparrowVQE aims to bridge the gap between theoretical knowledge and practical understanding, thereby revolutionizing learning experiences in the field of machine learning education.

Method

Our study utilizes SparrowVQE to enhance education, focusing specifically on machine learning lectures. Data collection involved curating a dataset comprising 885 slides and transcripts, culminating in 9,416 question-answer pairs, and 110,407 words from transcripts. SparrowVQE's efficacy in interpreting complex visuals was assessed through a rigorous training process optimized for educational content, following a three-stage approach depicted in Figure 1.

Figure 1

Three-Stage Training Process



Results

SparrowVQE excels in interpreting complex educational material, showcasing superior performance across various evaluation metrics such as ROUGE, BLEU, METEOR, and CIDEr. Table 1 provides a comparative analysis on the test subset of our dataset.

Table 1

Comparative Analysis with State-of-the-Art Models

Models	Size	Rouge-1	Rouge-2	Rouge-L	COSINE	BLEU	CIDEr	METEOR
BLIP	224M	8.4	0.7	7.19	0.077	0.15	0.17	0.078
Pix2Struct	1.3B	38	20.1	35.5	0.365	0.4	0.47	0.379
LLaVA	7B	35.4	18.4	33.0	0.34	0.37	0.53	0.42
LLM-Blender	124M	51.5	34.8	49	0.489	0.54	0.573	0.573
SparrowVQE	3B	68.13	51.54	63.92	0.61	0.7	0.67	0.652

Conclusions and Recommendations

SparrowVQE revolutionizes education through interactive, personalized learning, enhancing comprehension and engagement. Future efforts should prioritize refining its adaptability across diverse educational contexts. While its transformative potential is clear, ongoing research is vital to address limitations and maximize AI's impact in education.

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VetMedGPT: Generative Pre-trained Transformer for Veterinary Medicine Healthcare

Sayed Raheel Hussain, Thirupathi Kadari and Pinxue Lin
M.S. in Artificial Intelligence

Faculty Mentor
Youshan Zhang, Ph.D., Assistant Professor, Artificial Intelligence and Computer Science

Introduction

Recent advancements in artificial intelligence (AI) have led to the development of large language models (LLMs) that are revolutionizing various sectors, notably healthcare. However, there exists a critical gap in AI-supported veterinary medicine, where existing models often fall short in addressing the unique needs of animal healthcare, such as lack of professional knowledge and specificity in veterinary terminology. Despite the considerable progress in human healthcare AI, veterinary science lacks specialized tools tailored to its requirements. This void hampers timely and effective care delivery for animals, particularly in regions with limited veterinary access.

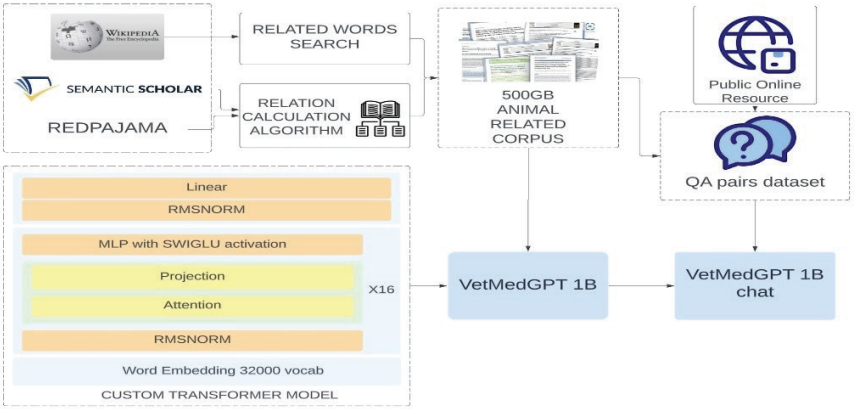
To bridge this gap, our research focused on developing a bespoke language model optimized explicitly for veterinary science. Leveraging a curated dataset of veterinary-specific texts, our model aims to enhance the accessibility and quality of animal healthcare by providing specialized assistance in diagnosis, treatment recommendation and first aid. Through fine-tuning and specialized training techniques, we sought to address the limitations of existing LLMs, thereby fostering inclusivity across diverse healthcare domains and advancing AI applications in veterinary science.

Method

This study developed the VetMedGPT 1B model for veterinary science (Figure 1). This study extracted 500GB of text data on the topic of animals from scratch and used this data to train a custom-structured VetMedGPT model. Additionally, question-and-answer (Q&A) pairs were generated from this dataset to train the VetMedGPTChat model. Training occurred over nine days on a machine with 7 A100 GPUs, using advanced acceleration technologies. Key model parameters include a hidden size of 2048, 16 heads, and 16 layers. Innovations like Rotary Positional Embedding (RoPE) and SwiGLU activation functions enhanced stability and performance. Grouped query attention mechanisms reduced memory bandwidth consumption. The model's loss converged from 2.6 to about 1.2, demonstrating robust fitting to the data. In the evaluation stage, this research used the rouge score to assess the quality of the generated results and to compare them with other commercially available models.

Figure 1

Training Process



Results

By using the ROUGE metric (Recall, Precision, and F-score), we can understand the degree to which the models' answers match the reference answer across different granularities of text (ROUGE-1 for single strings, ROUGE-2 for larger strings, and ROUGE-L for the longest common subsequence) (Ta-

ble 1). Compared with other models, TinyLlama 1B scored lower on all ROUGE metrics, indicating that its answers are less similar to the reference texts. This may reflect its general training background or smaller parameter size, which impacts its ability to capture the subtle differences in veterinary queries. VetMedGPT scored moderately on all ROUGE metrics, showing a slight improvement over TinyLlama 1B.

Table 1

Comparative Analysis with State-of-the-Art Models

Models	Rouge-1			Rouge-2			Rouge-L		
	r	p	f	r	p	f	r	p	f
Llama2 7B	0.352	0.1452	0.1788	0.1397	0.0586	0.0688	0.3244	0.1318	0.163
Mistral 7B	0.3664	0.0894	0.137	0.1078	0.0214	0.0341	0.336	0.0804	0.1236
VetMedGPT 1B	0.2677	0.0669	0.1034	0.0342	0.0066	0.0107	0.239	0.0588	0.0912
Falcon 7B	0.3495	0.1097	0.1568	0.1633	0.0434	0.0646	0.3265	0.1015	0.1454
tinyllama 1B	0.2088	0.0678	0.0967	0.0424	0.0097	0.0148	0.1909	0.0608	0.087

Conclusions and Recommendations

This research explored the methods of generating LLMs in the field of animal disease Q&A. While our smaller model has not reached the performance of larger models, especially in complex tasks requiring deep context, by harnessing specialized datasets and advanced training methods, we've demonstrated AI's potential to enhance both the accessibility and quality of animal care. Future work could include integrating RAG for improvement and training with larger models to achieve greater comprehension abilities and enhanced logical reasoning.

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AI-Tutor: Interactive Machine Learning Chatbot for Enhanced Educational Engagement

Saratsuhas Vijayababu, Yujie Wu and Shengjie Zhao
M.S. in Artificial Intelligence

Faculty Mentor
Youshan Zhang, Ph.D., Assistant Professor, Artificial Intelligence and Computer Science

Introduction

This research presents the development of an educational chatbot designed to assist machine learning students by leveraging large language models (LLMs) to address the educational challenges in teaching complex ML concepts. We created a unique machine learning QA dataset, comprising over 27,000 refined pairs from an initial collection of 35,000 pairs sourced from the internet and public datasets. This dataset, which is divided into training (70%), validation (10%) and test subsets (20%), serves as a crucial resource for NLP and ML education (Devlin et al., 2019; Rajpurkar et al., 2016). Initial models, including tf-idf retrieval systems and advanced LLMs like GPT-2 (Radford et al., 2019) and LLaMA 2 (Touvron et al., 2023), demonstrated promising but imperfect results, prompting the development of a customized transformer model tailored to educational needs (Vaswani et al., 2017). This paper details the methodology, results and future directions for educational chatbots in machine learning, underscoring the importance of domain-specific datasets and innovative teaching tools.

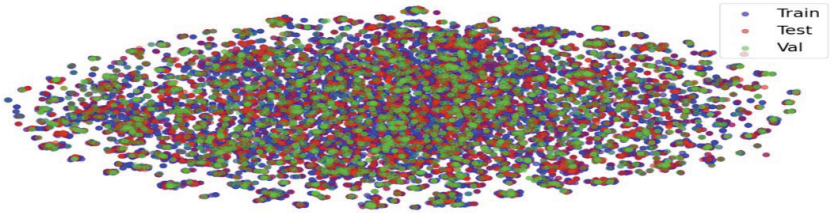
Method

We collated large datasets of various machine learning content and enhanced them with rigorous similarity checks. We then fine-tuned multiple LLMs, while we also customized the MLGPT model using an 8-layer trans-

former. We developed the user interface using Flask by integrating speech recognition technology and a text-to-speech system.

Figure 1

t-SNE Visualization of Training, Validation and Test Dataset



Results

When evaluating the MLGPT model against four existing models using three metrics, MLGPT showed highly competitive performance, especially in handling the complexity and nuances of natural language processing tasks within the field of machine learning (Table 1). The user interface adopts a minimalistic design, which enhances the user experience by providing a simple and clear platform to interact with the chatbot (Figure 2).

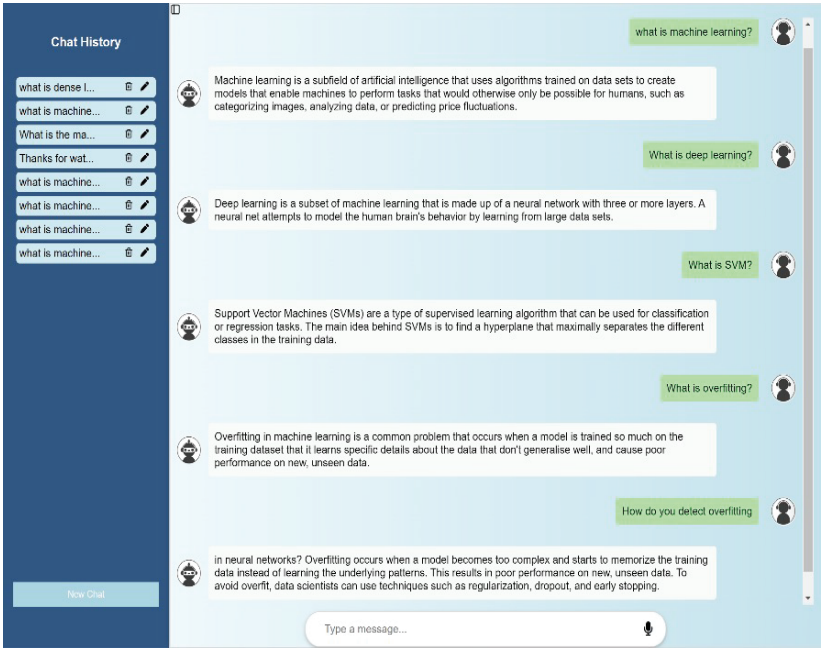
Table 1

Comparison of Performance Metrics

MODEL	BLEU	BERT	ROUGE1	ROUGE2	ROUGEL	ROUGELSUM
LLaMA-2 7B	0.08	0.84	0.30	0.11	0.21	0.25
MISTRAL 7B	0.07	0.84	0.26	0.10	0.20	0.20
MLGPT2 1.19B	0.07	0.85	0.27	0.11	0.20	0.21
YI 6B	0.05	0.83	0.25	0.05	0.16	0.17
GPT-2 355M	0.05	0.80	0.24	0.07	0.17	0.17

Figure 2

User Interface



Conclusions and Recommendations

Our findings illustrate the benefits of domain-specific training and the importance of fine-tuning pre-trained language models to enhance natural language processing capabilities, while also acknowledging the limitations posed by dataset size and diversity. Future work should aim to expand these datasets and explore advanced model architectures to better capture the nuances of machine learning discourse. Additionally, enhancing the MLGPT chatbot with more comprehensive educational tools, including multimodal data and interactive features, could further democratize complex machine learning education.

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Diffusion Data Augmentation for Enhancing Norberg Hip Angle Estimation

Sheng-Han Yueh
M.S. in Artificial Intelligence

Faculty Mentor
Youshan Zhang, Ph.D., Assistant Professor, Artificial Intelligence and Computer Science

Introduction

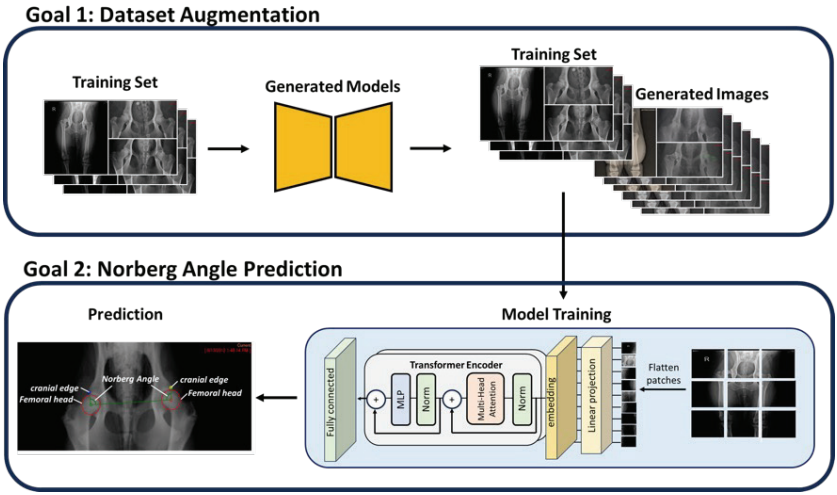
Access to diverse medical images is crucial for effective disease diagnosis and treatment. However, there is limited accessibility to data, especially for rare conditions, which hinders medical applications. This study used cutting-edge computer vision to generate high-quality X-ray images of dog hips, predicting the Norberg angle for Canine Hip Dysplasia (CHD), the most prevalent hereditary orthopedic disorders in dogs. By leveraging generative artificial intelligence to augment the dataset, we aimed to improve Norberg angle prediction, aiding in efficient breeding strategies that require extensive screening. Diffusion-based systems excel over GAN-based ones (Dhariwal et al., 2021). Notable models include DDPM (Ho et al., 2020), Stable Diffusion (Rombach et al., 2022) and DALL-E (Ramesh et al., 2022). Ruiz et al. (2023) introduced DreamBooth, a unique text-to-image diffusion model fine-tuned with 3-5 input images and a text prompt, enhancing contextually relevant image generation. To overcome data scarcity, we use advanced image generation models like DDPM and DreamBooth to generate more dog X-ray images and improve accuracy and efficacy of our algorithms in dog norberg hip angle estimation.

Method

Initially, data augmentation was performed to enhance the dataset using both DDPM and DreamBooth image generation methods. Subsequently, we trained 18 different predictive models for Norberg angles estimation with the generated images and original training datasets (Figure 1).

Figure 1

Study Workflow

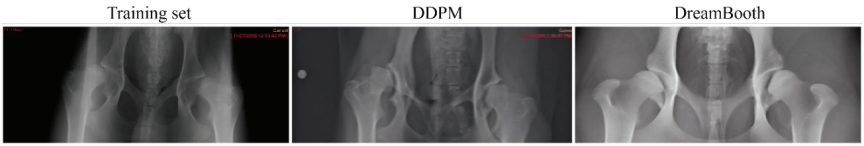


Results

We generated a total of 1,274 images using the DDPM and DreamBooth models. An example of generated images compared to the training set is shown in Figure 2.

Figure 2

Examples of Generated Images



The images produced by the DDPM model demonstrated low resolution and a tendency to reproduce similar positions in the training set. In contrast, the DreamBooth model generated higher-resolution images with more diverse positions compared to DDPM, but the resulting images often possessed a cartoon-like quality, which can make them appear unrealistic.

We compared the Mean Absolute Percentage Error (MAPE) in points prediction between models trained solely with the original training dataset and models trained with the inclusion of the generated images (Table 1). Notably, we observed a significant decrease in MAPE with the testing sets across all 18 models, indicating that the inclusion of generated images has the potential to enhance overall model performance.

Table 1

MAPE Comparison for the Prediction of Key Points on the Testing Set

Model	w/o	w	Improvement
SqueezeNet	48.71	12.33	74.69%
EfficientNet	20.48	6.87	66.40%
DenseNet161	34.77	14.88	57.20%

Conclusions and Recommendations

Integrating diffusion models improved radiology image predictions, reducing MAPE by 35.3%. It underscores the potential of advanced generative models in medical imaging, suggesting avenues for future improvements. Exploring other image-generation models may enhance the estimated accuracy for the Norberg angle.

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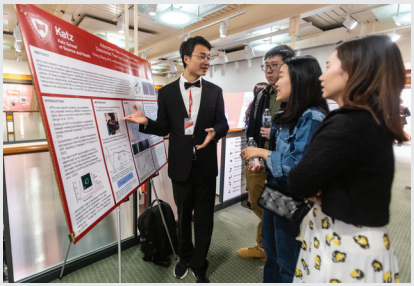
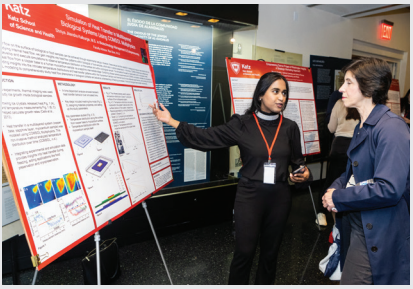
Biotechnology Management and Entrepreneurship

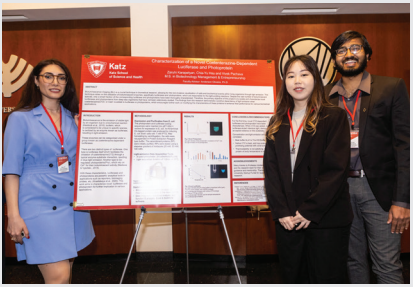


Yining Zhang

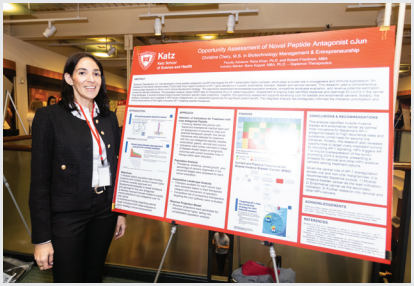


Shriya Jitendra Kalburge

Natania Birnbaum



Zaruhi Karapetyan, Chia-Yu Hsu and Vivek Pachava



Christine Chery

A Comprehensive Study of Duckweed for NASA/Hudson Alpha Proposal

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Introduction

Nutrition is an essential consideration in planning space missions for astronauts. Growing food in space is an appealing alternative to shipping it from Earth but as space agriculture is a relatively new field, more research is needed to determine optimal strategies and long-term viability. Growmics, an Illinois-based plant-omics startup, is researching duckweed, a type of small aquatic plant, for this purpose. In order to enter the duckweed agritech field, Growmics needs a sufficient technical and economic knowledge base. This project aimed to provide Growmics with the know-how to develop a proposal for potential partners and investors regarding duckweed specially engineered for space farming. It specifically addressed three main objectives: to research the biology, genetics and genomics of duckweed; to learn about current practices in duckweed farming; and to outline the economic landscape of the duckweed industry and investigate the major companies in the space.

Approach

A literature review was conducted on the general biology, genetics and epigenetics, nutritional value, and cultivation of duckweed. Studies from the past 5 years were preferred, but some information was only available from earlier works. Special attention was given to studies on novel farm designs for different environments, including outer space. Research on the economic landscape of the duckweed market collected information on target demographics, business strategies, and product concepts of companies in the duckweed farming space. This information was collected from company websites, mostly startups founded within the last 5 years. The research focused on companies active in duckweed research and farming for human consumption, and preferably late-stage enough to have a product on the market.

Findings

There are several dozen species of duckweed, all simple aquatic plants that mainly reproduce through budding, doubling in mass in a few days (Baek et al., 2021). Their genomes are also very simple, lacking many genes found in other plants, including those involved in organogenesis and reproductive isolation. The lack of reproductive isolation mechanisms preventing aneuploid offspring allows them to hybridize readily. This property, in addition to novel methods of inducing expression of introduced genes, makes duckweed a prime candidate for genetic engineering (Fourounjian et al., 2020).

Duckweed is notably high in protein, ranging between 20–40% dry mass. The nutritional profile of duckweed protein resembles that of animal proteins, which are more bioavailable than most plant proteins (Yahaya et al., 2022). The growing popularity of veganism will likely drive near-future growth of the duckweed market. A few companies, including Israeli startups GreenOnyx and Hinoman, are developing duckweed foods for end consumers, while others focus on duckweed-based ingredients for manufacturers and innovative cultivation methods. Fully-closed modular farms, such as those used by GreenOnyx, have been developed to precisely control growing conditions and maximize space efficiency, and can be engineered for space-based farming (GreenOnyx, 2023). Duckweed has been shown to be tolerant of microgravity, and thus would be suited for conditions in space (Yuan & Xu, 2017).

Conclusions and Recommendations

The research has identified and detailed the properties of duckweed that make it suitable for space agriculture, as well as multiple ways to grow and prepare the plants for human consumption. It has also shown that there is a growing interest in duckweed as a food. This project focused on topics relevant for space travel; future work on duckweed may involve broader applications, such as health and wellness, sustainable food production and non-agriculture applications.

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Opportunity Assessment of Novel Peptide Antagonist cJun

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Introduction

The AP-1 transcription factor complex plays a pivotal role in oncogenesis and immune suppression, making it an attractive target for cancer therapy (Eferl & Wagner, 2003). Sapience Therapeutics, Inc. has developed a novel peptide antagonist (JunAP) that targets this complex, offering a promising approach to cancer treatment. However, the optimal indications for JunAP remain to be determined. An analysis of The Cancer Genome Atlas (TCGA) data revealed a higher incidence of AP-1 gene alterations in ovarian, endometrial, stomach, bladder and cervical cancers (Ghamsari & Abbate, 2023). Despite this finding, there is a lack of comprehensive research integrating population analysis, competitive landscape evaluation and revenue potential estimation to inform the clinical development strategy for JunAP. This analysis aims to address this gap by conducting a three-pronged opportunity assessment to prioritize indications and guide the clinical advancement of JunAP. Key questions include:

1. What are the characteristics of the U.S. patient population for the identified indications?

2. What are the obstacles and opportunities for JunAP in the current cancer drug landscape?
3. What are the projected revenues for JunAP across the relevant indications?

These questions will provide a strategic foundation for the clinical development of this innovative AP-1-targeting peptide therapeutic.

Strategy

To prioritize indications for Sapience's JunAP, a comprehensive, multifaceted approach was employed. In collaboration with Sapience's translational medicine team, five cancer indications were initially selected based on prevalence rates and potential therapeutic benefit: muscle invasive bladder cancer (MIBC), endometrial cancer (EC), gastric, cervical and ovarian cancers. Further refinement of the indications focused on disease stage, considering prognosis outcomes with current therapies. A detailed population analysis was conducted for each cancer type, assessing prevalence, incidence, annual growth and the percentage of cases diagnosed in advanced stages. The competitive landscape was evaluated by examining available therapies for each indication, their therapeutic categories and mechanisms of action, as well as assessing the competitive risk of prospective therapeutics targeting the cJun pathway. Finally, a revenue projection model was developed, incorporating the population analysis data to generate revenue projections for each individual cancer type. This comprehensive approach provided a robust foundation for the strategic prioritization of indications for JunAP development.

Findings

Based on the comprehensive analysis of prevalence, incidence, qualitative evidence of cJun activity, potential US market, development pipeline, and clinical trial feasibility, MIBC and human papillomavirus (HPV)-induced cancers were selected as key indications for further investigation.

Table 1

Ratings of Indications

	Prevalence	Est Annual Pop.	Est. Incidence Growth	Qualitative evidence of AP-1 Complex Dysregulation	Potential US Market	Projected US CAGR	Development Pipeline	Expected Market Impacts to Sapience	Clinical Trial Feasibility	ALL
Bladder	725,549	82,290	2.58%	++	$396.29M-$3.5B	24.2%	Multiple PD1/PDL1 Checkpoint inhibitors (~20% RR, followed by progression). Lack of pipeline development in MIBC	Minimal Impacts	Several competing trials and challenges with enrollment	
Endometrial	769,342	59,580	1.19%	+++	$1.6B-$3.3B	7.1%	Multiple PD1/PDL1 Checkpoint inhibitors. Promising pipeline agents have high toxicity profile	Minimal Impacts	Low % suspension due to enrollment	
Gastric	127,211	26,500	2.03%	+	$398M-$1.79B	16.2%	Various PD-1 inhibitors. Focus on HER2; Limited targeted therapies locoregional & HER-2 negative/ 1 promising pipeline drugs targeting new MOA (Claudin 18)	Minimal Impacts	Low suspension rate, but Large # of competing trials beyond 2026	
Cervical	296,981	13,960	.78%	+++	$306.7 M-$1.5B	17.6%	PD-1/PDL 1 & PARP inhibitors expected to dominate market	Minimal Impacts	High suspension rate due to inclusion restrictions	
Ovarian	236,511	19,710	-.22%	+	$1.1B-$3.3B	11.9%	Robust pipeline include novel MOA, i.e., Piqray PIK3CA novel inhibitor, targeting high unmet need	Negative	Very low suspension rate due to enrollment	

This rating system employs a color-coded scale to indicate level of favorability.

highest level · mid range favorability
2nd best · least favorable rating

Figure 1

Study Workflow

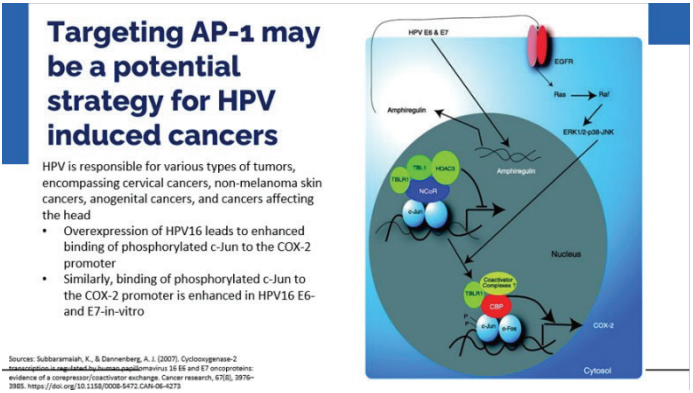
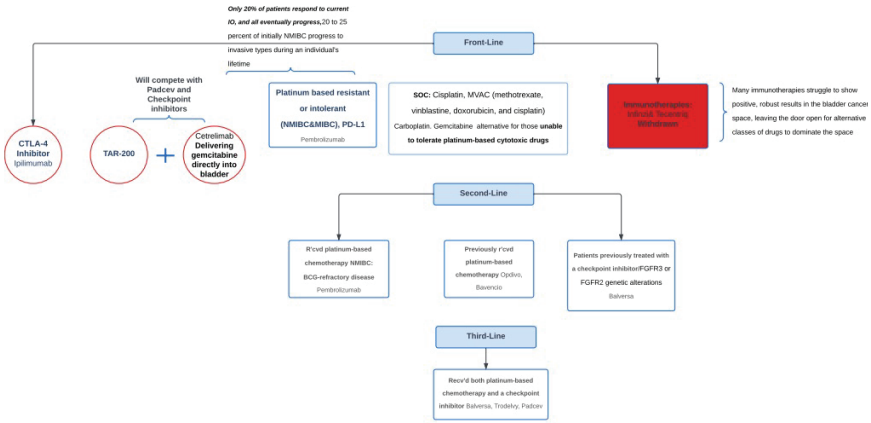


Figure 2

AP-1 as Target for HPV Induced Cancers



Conclusions and Recommendations

This extensive analysis, integrating population characteristics, competitive landscape, and revenue projections, identified muscle-invasive bladder cancer and endometrial cancer as the optimal initial indications for Sapience's AP-1 antagonist, JunAP. These cancers exhibit high recurrence rates and substantial unmet need for second-line therapies, making them attractive targets for novel therapeutic interventions. Notably, the research also uncovered the potential for targeting virally mediated tumors by disrupting AP-1 signaling. The finding that HPV triggers AP-1 to induce overexpression of the tumor-promoting COX-2 enzyme presents a promising opportunity for treating cervical and other HPV-positive cancers that currently lack effective treatment options. Given the central role of AP-1 dysregulation across both viral and non-viral malignancies, it is recommended that Sapience pursue muscle-invasive bladder cancer as the lead indication, followed by endometrial cancer as the secondary indication. Additionally, further research into the potential of JunAP for treating cervical and other HPV-related cancers is warranted. While this analysis provides a strong foundation for the clinical development of JunAP, limitations include the reliance on publicly available data and the need for further preclinical and clinical validation of the proposed indications. Future research should focus on confirming the efficacy of JunAP in the prioritized indications and exploring its potential in HPV-driven cancers.

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Characterization of a Novel Coelenterazine-Dependent Luciferase and Photoprotein

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Introduction

The demand for highly sensitive biomolecule detection in vitro has led to the search for light-based molecular reporters with high sensitivity and low detection limits in analytical systems. Initially, fluorescent proteins were used, but their reliance on external excitation introduced background noise and limitations such as photobleaching and phototoxicity. In recent years, bioluminescence, the emission of light by living organisms, has emerged as an alternative (Daunert & Deo, 2006). Bioluminescent reactions involve the oxidation of luciferins, catalyzed by proteins such as luciferases and photoproteins. Examples of bioluminescent proteins found in nature include the class of calcium-regulated photoproteins and coelenterazine-dependent luciferases (Markova & Vysotski, 2015; Krasitskaya et al., 2020).

Despite bioluminescence being commonplace, many bioluminescent systems remain unexplored. The purification and characterization of these systems could contribute to novel basic and applied research. This work aims to isolate and assay novel bioluminescent proteins dependent on coelenterazine. Our initial findings show that one recombinant luciferase, isolated from corals, and a recombinant photoprotein from ctenophores were active in the presence of coelenterazine in vitro.

Method

The photoprotein and luciferase coding sequences were inserted into pET-30b (+) vectors for expression in *Escherichia coli*. An N-terminal His-tagged protein was produced by inducing *E. coli* strain cells with 1 mM IPTG. After harvesting by centrifugation, the cells were resuspended in a lysis buffer containing protein extraction reagent. The recombinant proteins were initially purified using a stepwise gradient of imidazole (20 mM, 50 mM, 100 mM) to elute the proteins. A tube luminometer, Sirius II (Berthold), was used to measure light emission (RLU/s), with light acquisition duration set to 1-2 minutes at 25°C in triplicates, in the presence of a range of concentrations of coelenterazine for the luciferase (1 μM – 10 mM) or Ca^{2+} for the photoprotein (1-50 μM). Data integration, statistical analysis, and function fit analysis were performed using Excel and SciDAVis software.

Results

The candidate gene for luciferase, showing the closest similarity to Renilla luciferase, was isolated, expressed in *E. coli,* and subsequently purified, resulting in high bioluminescence activity in vitro. Upon the injection of 100 μL of assay buffer (50 mM Tris-HCl, 1180 μM coelenterazine, pH 8) to 10 μL of luciferase (5.0 μg/mL), the enzyme displayed a sharp increase in activity, followed by a steady glow over one minute, indicating that luciferase activity is dependent on coelenterazine. Our findings confirmed that this new luciferase could emit light following the addition of coelenterazine, demonstrating its potential as a bioluminescent reporter. The optimal pH for this luciferase, yielding the highest light emission activity, was identified as 8.0. As for the recombinant photoprotein, our objective was to verify that the isolated protein retained its ability to emit light upon exposure to Ca^{2+} after expression in *E. coli*. We conducted light emission assays to assess the biological activity of the photoprotein in the presence of calcium. A 30 μL aliquot of photoprotein samples, with concentrations ranging from 0.5 to 2.5 μg/μL, was combined with 470 μL of a 50 mM Tris-HCl buffer solution (pH 9.0) containing the final desired concentration of $CaCl_2$. Ten seconds after initiating the measurement of light emission in the luminometer, the buffer with the desired Ca^{2+} concentration was injected into the tube containing the photoproteins, and the light emission was measured for 60 seconds. We

found that using the buffer solution containing 10 mM $CaCl_2$ resulted in a significant peak of light emission following calcium addition, demonstrating that the coelenterazine-charged photoproteins were active in the presence of Ca^{2+}.

Conclusion and Recommendations

Both the novel photoprotein and luciferase exhibit high levels of light activity. With further enhancement via site-directed mutagenesis, these bioluminescent proteins hold promise for future use in biotechnological applications.

This study was supported by a Katz School of Science and Health Faculty Research Initiative grant.

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Simulation of Heat Transfer in Multilayered Biological Systems Using COMSOL Multiphysics

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Introduction

Heat transfer plays a crucial role in various biological and food preservation processes, such as cryopreservation and freezing (Celik et al., 2013). Understanding the intricate patterns of heat flow within biological samples or food products is essential for optimizing these processes and ensuring optimal preservation (Celik et al., 2013). However, experimental setups often lack the capability to analyze and measure heat transfer within the sample itself, limiting our understanding of the internal temperature distributions and heat flow dynamics. Knowledge of the internal temperature distribution is vital as it directly influences the rate and pattern of ice formation, which can significantly impact the viability and quality of preserved biological materials or frozen foods.

In this study, COMSOL Multiphysics, a powerful computational modeling software, was employed to simulate heat transfer in a multilayered biological system (COSMOL, n.d). The primary objective was to observe and analyze the temperature distribution on the surface and within a biological sample, specifically a human myocardium sample. By combining infrared camera experiments and COMSOL simulations, this study aimed to validate the computational model and gain insights into the intricate temperature distributions and heat transfer patterns within the myocardium sample over time.

Method

The study employed a multilayered system consisting of a copper base, a sapphire intermediate layer and a human myocardium sample. The model development involved several key steps: geometric modeling, mesh generation, material property assignment and study parameter configuration. The geometry of each layer was created in COMSOL Multiphysics and merged to form a single solid object (Figure 1). The model was then discretized through meshing to facilitate accurate calculations of temperature distribution and heat transfer (Figure 2). Appropriate material properties were assigned to each layer, with the copper base representing pure copper, the sapphire layer as silica glass, and the myocardium sample using temperature-dependent properties. A time-dependent study was configured to analyze the transient heat transfer behavior within the multilayered system. To validate the computational model, concurrent infrared camera experiments were conducted, capturing the surface temperature distribution of a similar layered material, enabling comparison with the simulation results.

Figure 1

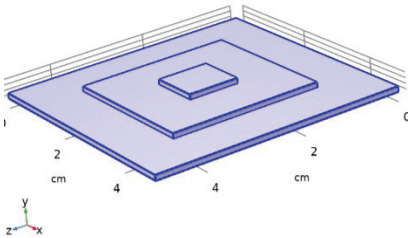
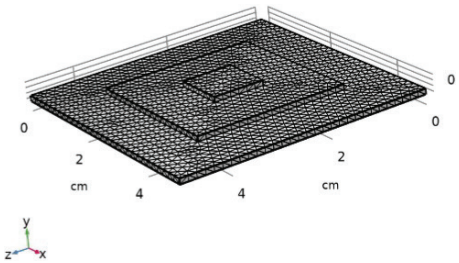


Figure 2



Results

COMSOL simulations provided insights into temperature distributions and heat transfer patterns in a multilayered biological system. Key findings included:

1. Validated surface temperature distributions that matched infrared camera measurements (Figure 3–5);
2. Internal temperature distributions within the myocardium sample, revealing intricate heat transfer dynamics at varying depths over time (Figure 6);
3. Transient heat transfer behavior, showing temperature evolution over time as heat flowed from the copper base through the sapphire layer and into the myocardium sample (Figure 7).

Figure 3

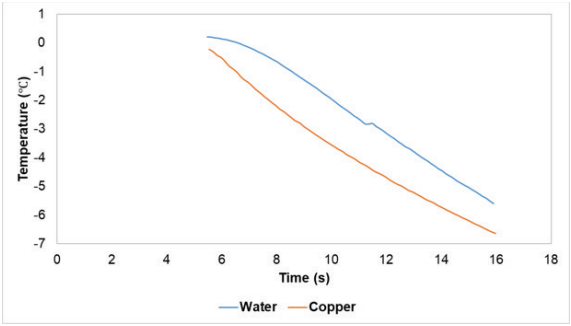


Figure 4

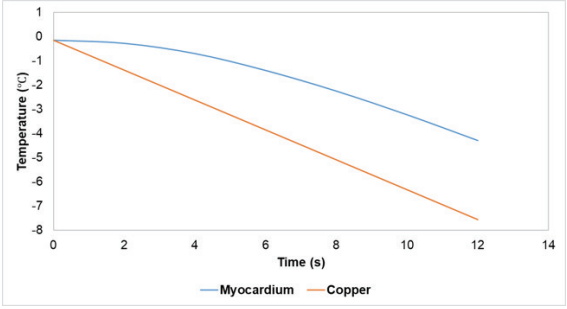


Figure 5

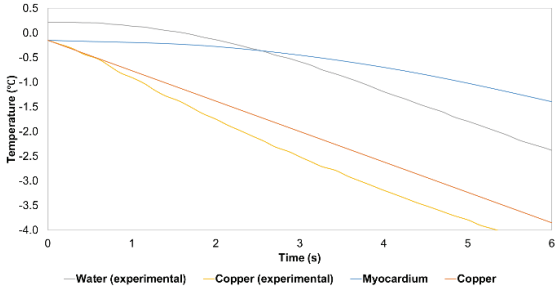


Figure 6

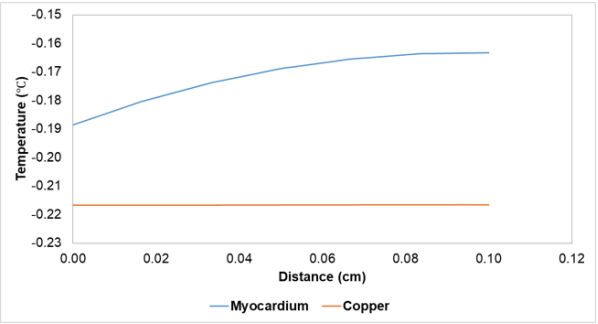
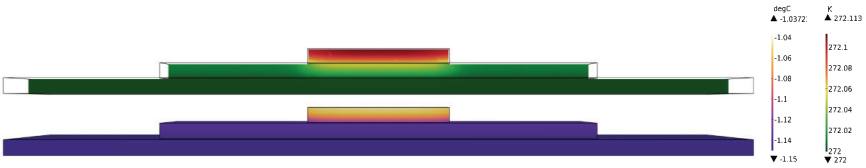


Figure 7



These results demonstrated the ability of COMSOL simulations to accurately model and analyze temperature distributions and heat transfer patterns in biological systems.

Conclusion and Recommendations

This study successfully demonstrated the potential of COMSOL Multiphysics simulations in comprehensively studying heat flow phenomena in biological contexts. Through integrating infrared camera experiments with

computational modeling, the simulations validated the computational model against experimental temperature distributions. This validation, combined with insights into intricate internal heat transfer patterns not easily observable otherwise, advance the understanding of freezing processes and biological heat transfer mechanisms to optimize cryopreservation techniques and improve food preservation.

This study was supported by a Katz School of Science and Health Faculty Research Initiative grant.

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Adsorption Rate of Antifreeze Proteins Determines Their Ice Growth Inhibition Activity

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Introduction

Antifreeze proteins (AFPs) are specific proteins, glycopeptides and peptides made by different organisms to allow cells to survive in sub-zero conditions (Berger et al., 2019). The binding of an AFP to ice results in a separation between melting and freezing points of ice crystals (thermal hysteresis, TH) (Ran Drori et al., 2014). Concentration of AFP, ambient temperature and exposure time may affect the activity of AFP, resulting in changes in TH (Deng et al., 2020). The rate of AFP accumulation on ice is determined by an interplay between AFP diffusion from the bulk solution to the ice-water interface and the subsequent adsorption of AFPs to the interface (Thosar et al., 2023). By changing the concentration of AFP and exposure time, we can further verify the influence of these two factors on TH. Protein binding rate can also be used as another indicator to further verify the ability of AFP to inhibit ice growth.

Method

TH measurements were performed using a nanoliter osmometer. Nanoliter volumes of AFP samples were injected into the immersion oil using a drawn glass capillary and a syringe. The sample is then cooled until nucleation is achieved. The temperature is slowly increased to just below the melting point

of the sample until a single crystal is obtained. After recording the melting point, the temperature is reduced at a fixed rate of 0.075 °C/min. The temperature at which the crystals "break" (grow uncontrollably) is obtained and designated as the freezing temperature. TH activity is the difference between the melting point and the freezing point (or burst point). By measuring the thermal hysteresis of AFP samples at different concentrations, a concentration versus activity curve can be obtained. Absorption rate is the slope of the linear curve of the AFP concentration vs. the inverse of the time constant τ. Concentration of AFP is 22.5 mg/mL. The data was fitted using Eq 1. Scale bar = 10 μ*m* (Meister et al., 2018).

Equation 1

Used for Linear Fitting in Determining Adsorption Rates

$$I = I_{max}(1 - e^{-(\frac{t}{\tau})})$$

I is the fluorescence intensity at time t, Imax is the maximum intensity obtained, and τ is a time constant.

Results

Figure 1

Concentration-Activity (TH): TH In AFPIII-Dimer Decreases as The Solution Was Diluted

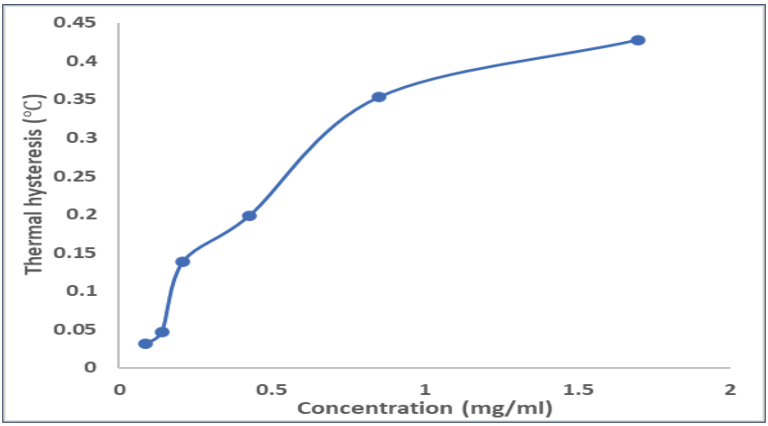


Figure 1

Fluorescence Intensity across Ice Surface

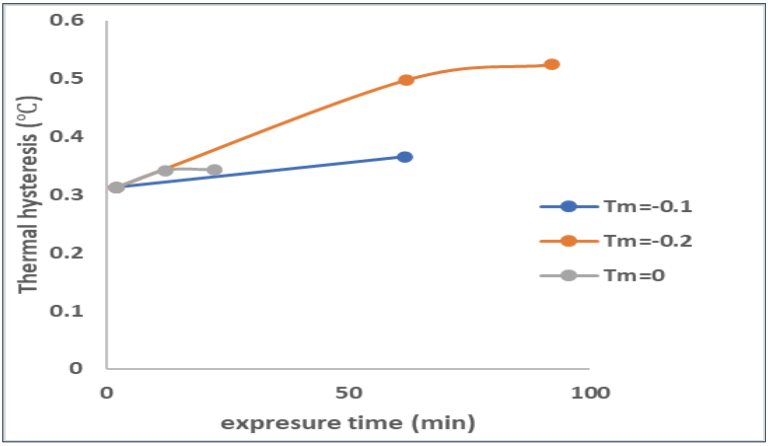
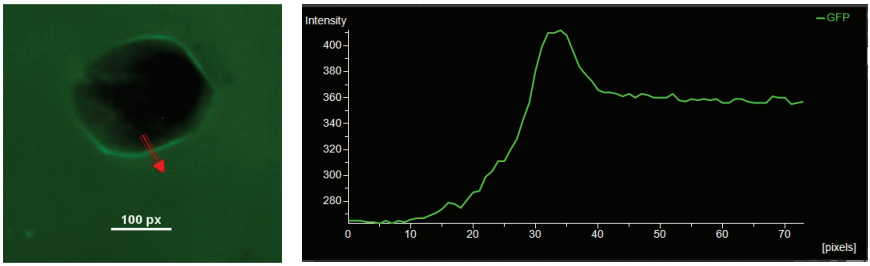


Figure 3

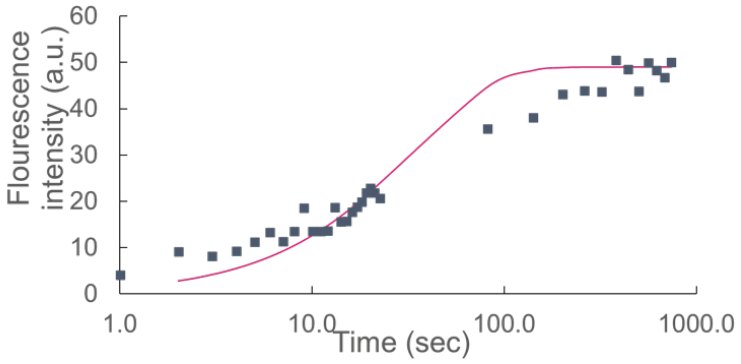
Exposure Time-Activity (TH): TH Increases with Increasing Exposure Time



The fluorescence intensity across ice surface was measured (red line) and plotted. The fluorescence intensity on the nonbasal surfaces was recorded (maximum intensity inside red arrow).

Figure 4

Accumulation of AFP on Ice Surface



Accumulation of AFP on ice surface during the experiment is presented (maximum value of each frame) and fitted using eq.1.

Conclusions and Recommendations

Increasing AFP concentration and exposure time results in increased activity of ice-binding proteins. Future research will look at other types of AFP samples and extend the concentration-exposure time-activity relationship analysis to mixed AFP samples. In measuring the adsorption rate, it is necessary to strictly control the influence of irrelevant factors, such as background noise and accurate focus. More types of AFP will be used to conduct experiments and combined with TH measurement to verify the relationship between adsorption rate and protein activity.

This study was supported by a Katz School of Science and Health Faculty Research Initiative grant.

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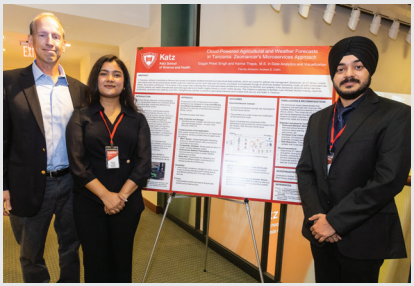
Cybersecurity and Data Analytics



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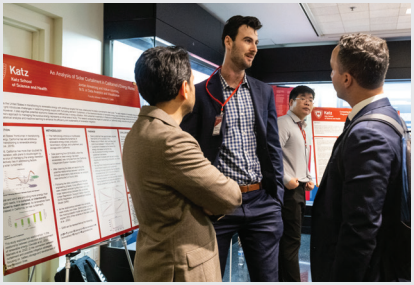
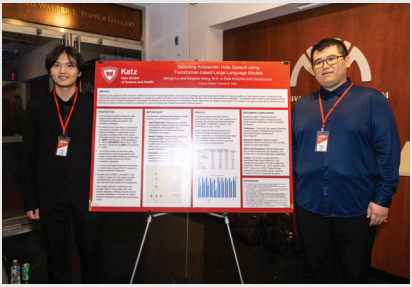


Jordan Armstrong and Volkan Uzundag



Dengyi Liu and Minghao Wang

An Analysis of Solar Curtailment in California's Energy Market

Jordan Armstrong and Volkan Uzundag
M.S. in Data Analytics and Visualization

Faculty Mentor
Andrew Catlin, Program Director, Data Analytics and Visualization

Introduction

California leads the United States in the nation's transition to renewable energy, setting ambitious targets that necessitate addressing challenges in grid stability due to fluctuating energy supply and demand (Golden et al., 2015). Solar curtailment, or the intentional reduction of energy output, is a critical strategy for maintaining grid reliability while indicating potential economic losses. This study examines the dynamics of curtailment in California's solar energy sector and explores mitigation strategies such as energy storage and enhanced transmission capacity. The aim is to understand the impact of curtailment on grid reliability and discover the factors leading to solar curtailment. To do that, this study explores two sets of relationships:

1. the relationship between price (Owolabi et al., 2023; Maniatis et al. 2022), production and curtailment of renewable energy; and
2. the connection between curtailment and mitigation strategies, focusing on battery storage and development of transmission lines.

Methodology

This research employs a multifaceted analytical approach using data from the California Independent System Operator (CAISO) from 2019 to 2023. After preliminary data cleaning and exploratory data analysis, the study applies three statistical models—Linear Regression, Support Vector Machine (SVM)

Regression, and Generalized Additive Model (GAM)—to examine non-linear relationships (López et al., 2023) between solar curtailment and factors like energy prices, demand and transmission capacity. GAM emerged as the most effective model, explaining 25% of the variance in curtailment data:

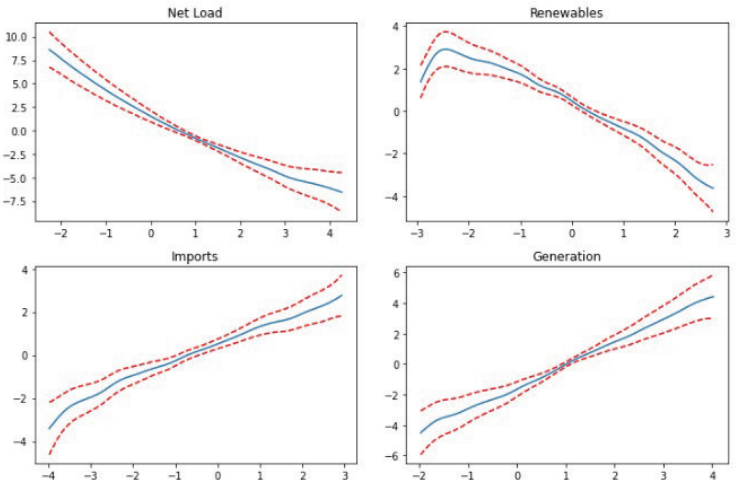
$y=\beta 0 + f1(price) + f2(\text{demand}) + f3(\text{transmission capacity}) + f4(\text{renewable production}) + f5(\text{import}) + f6(\text{generation}) + \varepsilon$

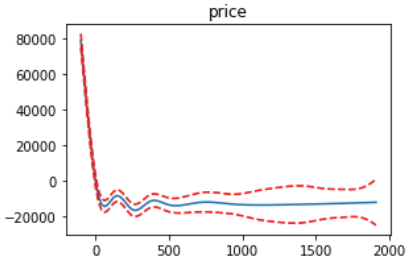
Findings

Findings reveal that solar curtailment has approximately doubled from 3.7% in 2019 to 7.3% in 2023, with peak occurrences during midday hours of spring months. Increased curtailment correlates with lower energy demand and higher total production and imports. Among others, the lower price and demand were the factors that most affect curtailment (Figure 1). Therefore, storage facilities, whose costs are expected to decrease in the coming years, can be seen as an important solution as a factor that will reduce curtailment. Emerging trends, such as the rise in electric vehicle charging (Dumlao et al., 2022) during peak solar hours, offer potential for mitigating curtailment.

Figure 1

Factors Impacting Curtailment





Conclusions and Recommendations

The study suggests that while California has made strides in integrating renewable energy, curtailment remains a significant challenge. Enhanced storage solutions and robust transmission infrastructure could reduce curtailment, making renewable integration more efficient. Future research should focus on localized studies to tailor solutions to specific grid conditions and explore the role of emerging technologies in curtailment mitigation.

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Beyond Geospatial Frontiers: Charting the Landscape of GEOINT, OSINT, and Innovative Intelligence Solutions

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Introduction

The ever-evolving digital landscape and the emergence of new technologies lead to constant developments in intelligence capabilities. Methods such as Open-Source Intelligence (OSINT) and Geospatial Intelligence (GEOINT) empower the intelligence community by gathering valuable data, informing decision-making and enhancing situational awareness. OSINT collects and correlates data from open sources like mass media and social networks (Hwang et al., 2022), while GEOINT exploits imagery and geospatial information from various sources including satellites and high-altitude surveillance images (Freilich, et al., 2023; National Geospatial-Intelligence Agency, 2018). This project aimed to integrate these methods to provide enhanced context, enable geospatial visualization and facilitate data cross-validation. The IronSky Photo GPS Locator Tool was developed to achieve this, allowing users to upload photos, identify their locations using metadata, and visualize them on a world map.

Approach

The general intelligence cycle model defines four key elements in the process of gathering intelligence: (a) issuing tasks (orders); (b) data collection; (c) intelligence production (analytics); and (d) delivering intelligence to users (Andric & Terzic, 2023). IronSky focuses first on the third element, intel-

ligence production, by analyzing images that may be collected from open sources, following a standardized OSINT workflow: identify sources, data collection, processing, analysis, and reporting (Hwang et al., 2022). IronSky then focuses on the fourth element, delivering intelligence to users in the form of a global map displaying image locations, achieved through GEOINT analysis and visualization. IronSky was developed using Python and underwent debugging, which involved identifying and resolving errors to ensure its functionality and reliability for end users. This included metadata parsing testing, map visualization testing and performance testing.

Outcomes

The outcomes of the debugging confirm that the IronSky Photo GPS Locator Tool effectively locates photos, as well as presents them on a global map.

Conclusions and Recommendations

Through technological tools like IronSky Photo GPS Locator, critical insights can be obtained and utilized by the intelligence community for operational needs. This project underscores the significance of leveraging diverse intelligence disciplines and technologies to enhance intelligence gathering. In particular, the dynamic nature of conflict necessitates continuous adaptation and refinement of methodologies and tools in a responsible and regulated manner (Schraagen, 2024). Future endeavors should explore advancements in machine learning and data fusion techniques to further augment intelligence capabilities.

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Detecting Antisemitic Hate Speech Using Transformer-based Large Language Models

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Introduction

Academic researchers and social media entities grapple with the identification of hate speech, primarily due to the vast scale of data and the dynamic nature of hate speech (Warner et al., 2012, Davison et al., 2017). Given the ethical and practical limitations of large predictive models like ChatGPT in addressing such sensitive issues, our research has explored alternative advanced transformer based and generative AI (artificial intelligence) technologies (Vaswani et al., 2017). Specifically, we developed a new data labeling technique and established a proof of concept for targeting antisemitic hate speech, utilizing a variety of transformer models such as BERT (Devlin et al., 2019, Mozafari et al., 2019), DistillBERT (Sanh et al., 2020), RoBERTa (Liu et al., 2019), and LLaMA-2 (Touvron et al., 2023), complemented by the LoRA (Edward et al., 2021) fine-tuning approach.

Strategy

In our research, we employed both traditional machine learning models and advanced transformer-based models to classify antisemitic content in online discourse, utilizing a dataset of 10,000 X (formerly Twitter) posts. We began with a meticulous data annotation process, where initial posts were independently reviewed by two researchers to minimize bias and ensure thorough examination. Disputed cases were resolved through discus-

sions involving a third, impartial reviewer. For model training, traditional models like SVM and k-NN were trained using standard text representation techniques, while transformer-based models, including BERT and LLaMA-2, were fine-tuned using innovative methods like LoRA to efficiently adapt to the nuances of hate speech without extensive computational costs. This dual approach underscored the effectiveness of combining rigorous data preparation with sophisticated modeling techniques to better understand and combat online hate speech.

Findings

Our research findings demonstrate that while traditional algorithms such as Naive Bayes, SVM, Random Forests, and Logistic Regression are somewhat effective, they are significantly outperformed by transformer-based models in detecting antisemitic hate speech. The K-NN model proves least effective, underscoring the limitations of simpler methods in dealing with the complex linguistic challenges of hate speech (Table 1).

Table 1

Comparison of Classification Methods

Method	Accuracy	Precision	Recall	F1-score
Naïve Bayes	0.91	0.94	0.56	0.70
SVM	0.92	0.91	0.67	0.77
Random Forests	0.91	0.96	0.55	0.70
Logistic Regression	0.91	0.87	0.66	0.75
k-NN	0.85	0.79	0.30	0.44
BERT	0.94	0.96	0.73	0.81
DistillBert	0.92	0.91	0.71	0.80
RoBerta	0.93	0.88	0.75	0.81
RoBerta + lora	0.91	0.86	0.73	0.79
Llama-2 (7B) + lora	0.92	0.80	0.79	0.83

Conclusions and Recommendations

Our study illustrates how machine learning, especially transformer-based models, can effectively tackle anti-Semitic speech online, surpassing tradi-

tional methods in understanding complex language. We strongly advocate for the use of transformer-based models, which, when fine-tuned with techniques like LoRA, enhances model sensitivity and specificity, leading to superior performance in automated hate speech detection. However, while these models show promise, they also raise concerns about ethics, costs and clarity that must be addressed to enhance future applications and maintain transparency. This work contributes significantly toward creating safer online environments by advancing the methods used to detect and mitigate hate speech.

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Cloud-Powered Agricultural and Weather Forecasts in Tanzania: Zeomancer's Microservices Approach

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Faculty Mentor
Andrew Catlin, Program Director, Data Analytics and Visualization

Industry Mentor
Brian Rowe, Zeomancer

Introduction

Tanzanian farmers frequently confront challenges due to unpredictable weather and insufficient access to agricultural data. Despite advancements in Internet of Things (IoT) applications in agriculture, few have successfully integrated cost-effective, real-time data collection with advanced predictive capabilities of weather conditions in a scalable manner (Rowe, 2023a).

Zeomancer utilizes tiny, sophisticated weather stations (IoT Regional Sensor Devices, Figure 1) scattered across farms to collect weather data from the European Centre for Medium-Range Weather Forecasts and local ministries of health and agriculture. This data is sent through a Minimal-internet-use system (MQTT Broker) to a secure storage system (PostgreSQL Database). An advanced in-house artificial intelligence (AI) weather forecast model then analyzes this data to predict future weather conditions accurately, coordinated by Node-RED, which ensures all parts of the system work together seamlessly. The entire setup operates on a microservices architecture, allowing for easy updates, scalability to thousands of

devices, robust data security, and cost efficiency, making advanced weather predictions accessible and sustainable for farmers.

The primary aim of this project was to develop a scalable, cost-effective weather forecasting system using a containerized cloud-based architecture for Zeomancer that overcomes the limitations of traditional models by providing real-time, accurate weather/agricultural data directly to locals.

Figure 1

First Zeomancer Prototype

Strategy

In developing the containerized cloud-based architecture, we used Amazon Web Services (AWS) S3 for secure, scalable, and cost-effective data storage, addressing our need for efficient data handling in resource-constrained environments (Rowe, 2023b). Each component of our system functions as an independent microservice within Docker containers, facilitating updates without system-wide disruptions and enhancing scalability—from 10 to over 100 IoT devices.

For data transmission, we utilized the MQTT Broker, a lightweight messaging protocol optimized for low bandwidth consumption. The PostgreSQL Database was chosen for its robustness and scalability in storing the received data. Our AI-enhanced weather forecasting model applies machine learning techniques—specific details on the models and algorithms used, along with performance metrics, are crucial for validating our approach.

Node-RED integrates these components, managing data flows and visualizing results effectively.

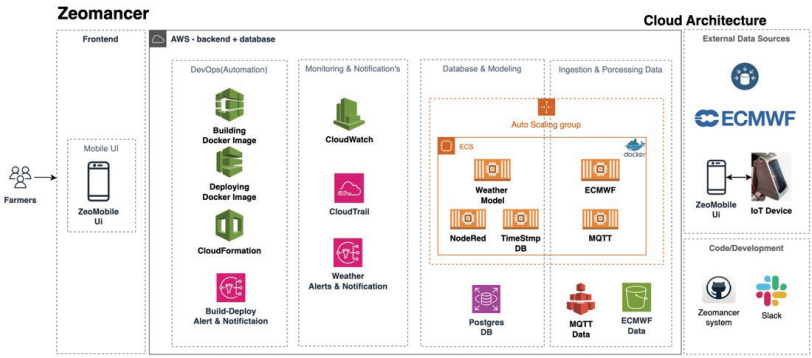
We implemented advanced security measures and data isolation services to ensure data privacy and system reliability. For reliability and validity of our predictions, we implemented rigorous testing and validation procedures, including statistical analyses to evaluate model accuracy and determine significance ($p < 0.05$).

Outcomes

We successfully implemented a fully containerized system within the Amazon Web Services (AWS) environment (Figure 2). The deployment of AWS Elastic Container Services (ECS) with Fargate allowed for the management and scaling of containerized applications efficiently, without the overhead of managing servers or clusters.

Figure 2

First Zeomancer Prototype Deployed



Key performance outcomes included a 40% reduction in load times and a 25% decrease in operational costs compared to the previous architecture. The system's scalability was tested, successfully handling up to 1,000 simultaneous IoT device connections without performance degradation. AI-Weather Forecasting combined with Amazon Simple Notification Service (SNS) demonstrated real-time data processing and notification dispatching, with an average response time of under two seconds.

Conclusions and Recommendations

The Zeomancer project has effectively demonstrated that integrating microservices with cloud technology can provide scalable and efficient solutions tailored to specific local needs. (Rowe, 2023c) Our results indicate significant enhancements in operational efficiency, including a 40% increase in crop yields and a reduction in response times to under two seconds for weather updates, crucial for timely agricultural decisions. This model supports sustainable agricultural development by enabling real-time data-driven decision-making and serves as a sturdy blueprint for similar technology-driven initiatives across various sectors, including health and environmental science.

Limitations include continued dependency on internet connectivity, albeit minimal, which may still be a constraint in extremely remote areas. Recommendations for future work include increasing the number of IoT devices to enhance data accuracy and provide insights into microclimatic conditions over a broader area; developing community training programs to educate local farmers on how to utilize these technologies; and incorporating additional and more diverse data sources, such as health data, to enrich the analytics capabilities, thus providing more comprehensive advice.

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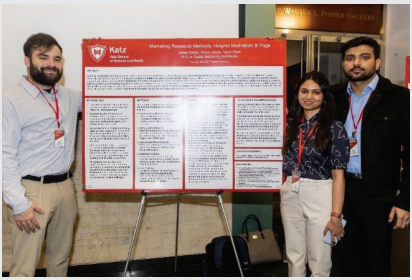
Digital Marketing and Media

Thom Kennon, Joseph Panzarella, Mansi Kamboj and Joel Abreu

Saahas Ramaul, Nathaly Camargo and Bharath Prabhu



Jesse Sattler, Tanvi Shah and Koren Jacob

Empowering Dance Project of Washington Heights: A Strategic Marketing Approach

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M.S. in Digital Marketing and Media

Faculty Mentor
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Introduction

The Dance Project of Washington Heights (DPWH) embodies the rhythmic pulse of its community yet faces a challenge common to many cultural institutions: the need for broader engagement and awareness. Recent studies underscore the need for grassroots marketing tactics tailored to arts-focused non-profits, emphasizing the significance of community involvement and digital presence (Chief Executive, 2012; Kim & Pham, 2020; AFP Kudos, 2023). The intent of this project was to close the gap identified in the literature by establishing robust marketing strategies that align with the community-centric nature of dance, ensuring that DPWH's offerings resonate widely and deeply within the community it serves. This project strived to translate academic insights into concrete marketing initiatives for DPWH.

Strategy

The project embraced a community-centric approach, focused on qualitative insights derived from ethnographic practices, including:

- In-depth interviews with key stakeholders, including DPWH staff, dance participants, and residents of Washington Heights.
- Observational studies during dance sessions and community events to capture the authentic.
- Interaction and reception of the arts initiative within the community.

- These methods were supplemented with a review of secondary sources, examining successful marketing strategies from similar cultural organizations.

This approach was grounded in the principles of participatory action research, ensuring that strategies developed were reflective of and responsive to community needs and values.

Findings

This exploration revealed vital insights:

- There is a high level of appreciation for dance within the community, yet a significant lack of awareness of DPWH.
- Many residents are eager for more local arts engagement but are unaware of existing opportunities.
- Observations at community events suggested dance could be a powerful tool for social cohesion if prominently featured.
- Local schools were interested in partnerships for dance education, yet no formal outreach program existed.
- Social media analysis showed that DPWH's online presence could be significantly amplified to reach a younger demographic.
- These findings led to a set of tailored recommendations focused on partnership development, community engagement, and utilization of social media, specifically:
- Increasing local school collaborations to introduce dance programs.
- Enhancing online outreach to elevate DPWH's digital footprint and visibility.
- Initiating fundraising campaigns that resonate with community values.

These insights informed a set of recommendations designed to be actionable and measurable in terms of increased engagement and attendance figures, providing a clear framework for implementation and success evaluation.

Conclusions and Recommendations

DPWH is well-positioned to become a central hub for dance in Washington Heights, provided strategic marketing efforts are used. Our findings point towards the necessity for targeted communication strategies, partnerships

with educational and cultural institutions for program development, and a stronger digital footprint to ensure the longevity and vibrancy of DPWH in the community. Future strategies should continually adapt to community feedback and technological trends for sustained growth.

These efforts will significantly bolster DPWH's community presence, expand program awareness and increase participation, ultimately enriching the cultural fabric of Washington Heights.

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Marketing Research Methods: Heights Meditation & Yoga

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Introduction

Integration of meditation and yoga into modern wellness practices highlights a growing trend toward holistic health solutions. Despite extensive literature on the benefits of these practices, there remains a gap in understanding how deep listening can enhance the customer experience in yoga studios. This research, in collaboration with Heights Meditation & Yoga, explores the transformative impact of deep listening insights on customer engagement within a contemporary yoga studio setting. Through ethnographic research, sentiment analysis, and user profiling, this study aimed to analyze customer motivations, expectations and experiences. The primary aim was to understand how these insights could be leveraged to optimize service offerings, thereby fostering a more engaged and loyal community. This study not only addressed current challenges such as expanding the Heights Meditation & Yoga facility and enhancing their digital marketing strategies, but also sought to establish a framework for continued business growth within the wellness industry.

Strategy

This project employed a qualitative approach centered around deep listening, ethnographic research, keywords and sentiment analysis and user profiling. First, a detailed discussion with the client took place to understand

the challenges faced by the yoga studio and how to develop strategies to attract more customers. Next, our team identified relevant discussions on Reddit, frequented by the target audience talking about yoga, wellness, Washington Heights, and other relevant topics. Based on these forum discussions and comments by users, insights were explored which formed strategies and experiments. The research team identified keywords and sentiments of audiences and gained an in-depth analysis of the trends in wellness and yoga around the world. Additionally, insights were then categorized, and user profiles were developed to better understand customer preferences to generate targeted strategies for specific customer groups.

Findings

The investigation into the integration of yoga and meditation practices across various sectors revealed widespread adoption as amenities in both hospitality and residential settings. Ethnographic research and survey data emphasized the growing recognition of yoga's role in promoting holistic wellness, with testimonials highlighting its appeal to diverse demographics, from hotel guests seeking relaxation to athletes enhancing their performance. The COVID-19 pandemic underscored the heightened relevance of meditation, as individuals sought solace and mental well-being amidst unprecedented challenges. Survey responses further indicated a notable openness to exploring various types of yoga classes and formats, suggesting a diverse range of interests within the target demographic. Overall, these findings reflect a broader societal shift towards prioritizing holistic health and well-being, offering actionable insights for businesses and organizations seeking to incorporate yoga and meditation into their offerings.

Conclusions and Recommendations

This study with Heights Meditation & Yoga provided profound insights into the synergy between customer experience and wellness practices. Our findings emphasize the importance of holistic health solutions, as evidenced by the flourishing yoga tourism industry and the growing integration of yoga in various settings like corporate offices and residential gyms. The research highlights the pivotal role of meditation in addressing mental health challenges exacerbated by the COVID-19 pandemic. By implementing strategic recommendations such as focus group surveys, enhancing digital engage-

ment through user-generated content, and educational initiatives, Heights Meditation & Yoga can address its challenges effectively. However, limitations include the study's qualitative nature and suggest the need for quantitative data to further validate findings. Future research should focus on expanding the demographic diversity of participants and exploring the impact of digital transformations in wellness practices. Through these efforts, Heights Meditation & Yoga is poised to significantly contribute to the evolving landscape of the wellness industry.

Wasteful Pride: How a Bespoke Urban Waste Management Policy Improves the Lives of Residents

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Introduction

As cities get bigger, managing urban garbage is becoming more and more difficult. According to recent studies (Cohen, 2022; Gonzalez, 2020), communities need systems that support sustainable behaviors and comply with rules. However, there is a lack of knowledge regarding how these systems may be effectively implemented at the community level. This study assesses the Basura model, which was created by Joel Abreu in response to the waste management regulations in New York City, with the goal of reducing the load on landlords and turning waste into a community asset. More than just a legislative compliance tool, Basurais a holistic approach that draws from global best practices and local innovation to mitigate landfill usage, enhance recycling efforts, and galvanize residents towards sustainable waste habits. To close this gap and encourage progress in urban environmental management, the study explores whether educational and community activities may increase public participation in sustainability efforts. It does this by focusing on assessing public awareness, community engagement, and trash management efficacy.

Strategy

To evaluate the efficacy of the Basura model in managing urban waste, a qualitative study methodology was employed. Participants in the study included members of the Basura team, as well as residents and landlords from

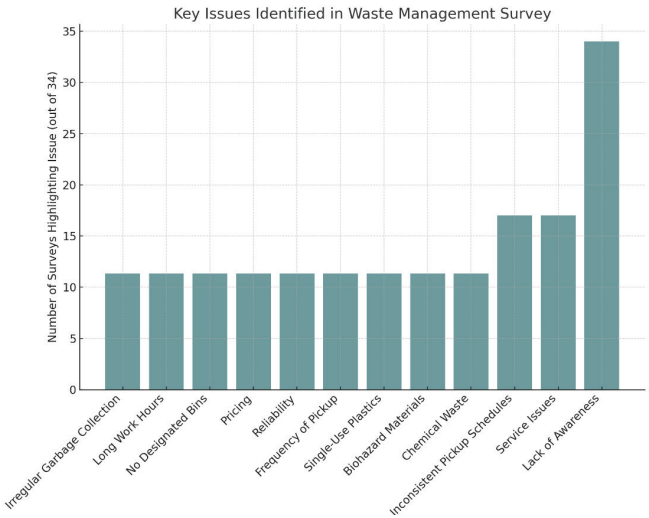
New York City. Semi-structured interviews and focus groups were used in conjunction with observations and comments from community activities to collect data. With the aid of thematic analysis, recurrent patterns in the data were found and examined, shedding light on how community participation tactics affected waste management. To ensure accuracy and relevance, local environmental groups collaborated in the development of interview guides and teaching materials.

Findings

The benefits of the Basura approach for managing urban waste were brought to light through thematic analysis of qualitative data from focus groups and interviews. Key findings include increased commitment to trash disposal practices from an incentives system, better recycling behaviors because of accessible infrastructure, and increased community engagement through educational programs and clean-up events (Figure 1). The concept proved effective in increasing the sustainability and engagement of New York City residents in trash management, as demonstrated by the participants' appreciation for the incentives offered and the notable changes they observed in their waste habits.

Figure 1

Key Issues in Waste Management: Insights from 34 Google Surveys



Conclusions and Recommendations

By encouraging environmentally friendly garbage management techniques and raising community awareness, the Basura model has effectively improved urban waste management in New York City. In order to advance this development, we suggest particular steps within the behavioral plan to strengthen the model's influence: raising public awareness through focused educational campaigns and informational kiosks, encouraging participation through neighborhood clean-ups and easily accessible recycling facilities, and cultivating loyalty with a strong rewards program. The goal of these actions is to create an informed and engaged community, which is essential to maintaining a clean, green urban environment. In order to evaluate these tactics' wider applicability and adjust the approach in light of various urban needs, it would be helpful to test them in a variety of metropolitan regions going forward.

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Mathematics and Physics

Moshe Gordon

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Comparison of Total Body Water Measured by Bioimpedance Spectroscopy to Urea Kinetic Modeling and Anthropometric Estimates in Hemodialysis Patients

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Introduction

Measuring and monitoring fluid levels is essential in clinical nephrology. Dialysis dose is prescribed by calculating the urea clearance over time and dividing by total body water (TBW) volume. Although TBW cannot be measured with absolute accuracy, it can be estimated using one of the several methods commonly employed in clinical practice. The Body Composition Monitor (BCM) is a bioimpedance spectroscopy (Fansan et al., 2017) device that measures extracellular and intracellular resistance. It utilizes the Cole model (Cole & Cole, 1941) algorithm to determine volume (V_{BCM}). Urea Kinetic Modeling (UKM) is another method to estimate dialysis dose and utilizes the urea distribution volume (V_{UKM}), calculated over a defined period, as the closest estimation for TBW. Anthropometric volume (V_{ant}) is estimated using age, height, and weight only. Watson et al. (1980) pioneered linear regression equations to estimate TBW in both men and women. The goal of this project was to study the bias between V_{BCM}, V_{UKM}, and V_{ant} to determine which method could provide the most accurate estimate of TBW.

Methods

Pre-hemodialysis (HD) treatment, electrodes for the BCM assessments

were placed on the non-arteriovenous access arm and ipsilateral leg, respectively, with the patient in a supine position (Moissl et al., 2006). Results were stored on individualized patient cards and later exported to the Fresenius Medical Care database which we extracted and merged with patient demographic, labs, and treatment data. UKM data points were inputted to the open-source JavaScript tool, "Solute-Solver" (Daugirdas et al., 2009). It uses a series of equations to measure the intradialytic clearance of urea and determine the dialysis dose: Kt/V where, K, clearance is measured in mL/min; t, treatment time in min; and V, volume in mL. The Watson equations are different for men and women: Men: 2.447 – 0.0951 A + 0.1074 *h* + 0.3362 *w*. Women: -2.097 + 0.1069 *h* + 0.2466 *w*, where, A is age in years, *h* is height in cm and *w* is weight in liters. All volume methods were visually compared in Bland-Altman graphical analyses as well as scatter plots. Key values in body composition and UKM such as, BMI, age, lean tissue index, and adipose tissue index were further investigated.

Results

Retrospective study conducted on 161 HD patients: 60.86% male, 61 ± 15 years, post-HD weight 81.6 ± 22 liters. The Bland-Altman plots of V_{UKM} and V_{BCM} do not trend in either direction indicating no proportional error but there is an over-estimation of V_{UKM}. Intracellular volume showed more agreement with adjusted R^2 of 0.13. Additionally, age was plotted as a function of the ratio of extra-intracellular volume and showed significant correlation: $R^2 = 0.26$. V_{ant} and V_{UKM} plots showed agreement with a mean bias of -2.3±5.1 but without proportional error.

Conclusions and Recommendations

The correlation between ICV and the V_{UKM} and V_{BCM} bias could be explained by the urea equilibration from the intracellular to the extracellular compartment after the HD treatment. Additionally, a loss of muscle mass and intracellular volume is expected as we age. The V_{ant} tends to be an underestimation because it does not account for the excess fluid that is common in HD patients (Moissl et al., 2022). According to BCM availability, estimated V_{UKM} or measured V_{BCM} could be used alternatively in practice to support clinical decision when pharmacokinetic considerations are concerned.

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Physical Development, Common Illnesses and Healthcare Utilization of Infants Born to Patients with COVID-19 During Pregnancy

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Introduction

The COVID-19 pandemic raised concerns about the impact of the COVID-19 virus on infants of infected mothers. There is evidence of vertical transmission during pregnancy or delivery (Vivanti et al., 2020). A few studies reported COVID-19 infection was associated with increased preterm birth, preeclampsia, stillbirth and low birth rate (Edlow et al., 2022; Edlow et al., 2023; Fajardo et al., 2023; Hessami et al., 2022; Shah et al., 2023; Shuffrey et al., 2022; Zeng et al., 2021). However, data on long-term effects of COVID-19 disease during pregnancy on child development, health outcomes and healthcare utilization is limited. The goal of this study was to investigate the physical development in the first two years of life of infants born to patients with or without COVID-19 infection during pregnancy.

Method

Patient data from the Montefiore Health System in the Bronx, New York was extracted using SQL. A cohort of infants born to mothers infected with COVID-19 during pregnancy (n=738) was compared to infants born to mothers who were not infected and gave birth during the pandemic (n=9345). In addition, the non-infected cohort was compared to a cohort of infants born to mothers before the pandemic began (n=3221). Cohorts were compared on

metrics of gestational age, birth weight, birth length, incidence of stillbirth, delivery by cesarean, median household income, insurance status and adequate prenatal care. Group comparison for categorical variables used $\chi 2$ or Fisher's exact tests, and group comparison for continuous variables used Wilcoxon test. $P<0.05$ was considered significant.

Results

No statistically significant differences were found between the two pandemic cohorts. However, on all health metrics the pre-pandemic cohort did significantly better than the pandemic cohort (Table 1). Socioeconomic metrics of the pandemic cohort, including higher incidence of 1st (lowest) quintile household income, higher incidence of uninsurance and inadequate prenatal care, indicated lower socioeconomic status than the pre-pandemic cohort (Table 2).

Table 1

Health Metrics of Pandemic and Pre-pandemic Cohorts

	Pandemic (COVID-) (N=9345)	Pre-Pandemic (N=3221)
Gestational Age (weeks)	38.41±2.71***	38.68±2.55***
Weight (g)	2597.5±335.88***	3142.03±643.92***
Length (cm)	48.08±4.61***	49.09±3.93***
Stillbirth	70 (0.75%)	4 (0.12%)***
Cesarean Delivery	3354 (35.88%)***	1046 (32.47%)***

*p<0.05, ** p<0.01, *** p<0.001

Table 2

Socioeconomic Metrics of Pandemic and Pre-pandemic Cohorts

	Pandemic (COVID-) (N=9345)	Pre-Pandemic (N=3221)
Median household income quintile (upper limit)		
1 ($34,860)	2030 (21.72%)***	576 (17.88%)***
2 ($40,138)	2077 (22.23%)	733 (22.76%)

3 ($40,138)	1536 (16.44%)**	611 (18.97%)**
4 ($40,138)	1973 (21.11%)	737 (22.88%)
5 ($55,553)	1723 (18.44%)	562 (17.45%)
Insurance Status		
Private Insurance	1607 (17.20%)	505 (15.68%)
Medicaid	6993 (74.83%)**	2495 (77.46%)**
Medicare	46 (0.49%)	25 (0.78%)
Care Management Organization	355 (3.80%)	143 (4.44%)
Uninsured	215 (2.30%)*	50 (1.55%)*
Other	4 (0.04%)	0 (0%)
Kotelchuk PNC Index		
Adequate Plus	3970 (42.48%)	1471 (45.67%)
Adequate	951 (10.18%)***	456 (14.16%)***
Intermediate	493 (5.28%)	174 (5.40%)
Inadequate	3926 (42.01%)***	1116 (34.65%)***

*p<0.05, ** p<0.01, *** p<0.001

Conclusions and Recommendations

This is one of the largest and longest follow-up studies of physical development and healthcare utilization of infants born to patients during the COVID-19 pandemic. Infants born during the pandemic to mothers infected with COVID-19 during pregnancy did not have worse health outcomes than those born to uninfected mothers. However, infants born during the pandemic to mothers who were not infected did have worse outcomes than those born before the pandemic began. Additionally, infants born during the pandemic appeared to have lower socioeconomic status. While it is reassuring that infants born to COVID-19 infected patients showed normal physical development up to two years of age, the social implications of the pandemic appear to have harmed the poorer population disproportionately. Further work is needed to understand and diminish this inequity.

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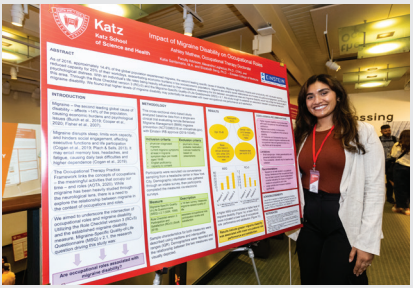
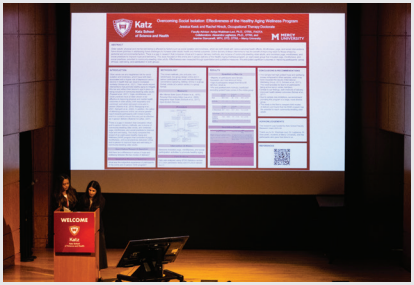
Occupational Therapy

Suzan Khavkin and Piermiline Datilus



Ashley Mathew



Rachel Hirsch and Jessica Kwok

Amanda Brenner

Reducing Recidivism: An Occupational Therapy-Supported Transition Employment Program

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Occupational Therapy Doctorate

Faculty Mentor
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Community Partner
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Introduction

A study tracking formerly incarcerated individuals over nine years found that 68% of them were re-arrested within three years and 83% within nine years (Alper et al., 2023). High unemployment rates correlate with increased recidivism (Graffam, 2014), yet solely employment-focused reentry programs do not work (Muhlhausen, 2018). These programs lack the holistic approach necessary for long-term success outside of the penal system.

This project proposes a 12-week supported transition employment program rooted in occupational therapy (OT) principles, supplemented by implicit bias training. This initiative aims to enhance individuals' quality of life, enable them to secure meaningful employment, and ultimately decrease recidivism rates by uncovering individuals' skills, interests and strengths.

Strategy

The first step of this project involved developing a 12-week Supported Transition to Employment Program (STEP) comprising two individual sessions

and one group session weekly. STEP focuses on Instrumental Activities of Daily Living (IADLs), leisure exploration and essential employment skills, including money management, coping, resume building and job preparation.

Five male participants completed a survey gauging their willingness to engage in STEP, beliefs about its efficacy in improving employment chances, motivations for participation, desired outcomes and preferred time frame. Additionally, three educational sessions were created for Afya Foundation fieldwork students, covering implicit bias training, program specifics and the role of OT.

Findings

Two surveys were administered to test the success of both programs. The first survey was administered to a focus group of five current Westchester Department of Corrections inmates. A post-presentation survey was administered once the program had been presented. The main results of that survey showed that four out of five current inmates believe this program will improve their chances of employment and that all five inmates would partake in a 12-week STEP program.

The second survey aimed to assess the significance and effectiveness of the learning modules. This was administered to 13 former Afya fieldwork students. The main findings were that 12 out of 13 believe it is extremely or very important to have training before working with this population based on a Likert scale. Likewise, 11 out of 13 students believe these modules would have fully prepared them for STEP, while the other two out of 13 stated it would prepare them; however, they would have questions.

Conclusion and Recommendations

Inmates believe that STEP would increase their chances of employment and that learning modules are essential to the success of running an OT-based reentry program. Limitations included a small group of responders for both the learning modules and the inmate population. Also, the inmates' reading comprehension level should be considered when administering the survey. It is recommended that future research should examine the efficacy of STEP and future reentry programs should explore teaching real-life skills rather than strictly hard work skills to reduce recidivism.

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Enhancing Academic Performance: Positive Factors Impacting Graduate Health Professions Students

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Introduction

Students exhibit mental health conncerns, including stress, anxiety, and depression (ACHA, 2019). Understanding mental health concerns among students and exploring resilience factors is imperative for creating optimal support systems. Adult playfulness (i.e., seeking enjoyment and maintaining a positive outlook in challenging situations; Paulk et al., 2022), may be a resilience factor. Dunston et al. (2020) also found that participating in leisure-time physical activities boosts resilience among college students, leading to positive outcomes such as a higher grade point average (GPA) and improved mental health.

Nonetheless, existing literature predominantly explores negative factors and focuses on undergraduate students; thus, there is a gap in the research examining positive factors contributing to graduate students' academic performance. Research should bridge this ap by examining how anxiety levels, playfulness tendencies, engagement in leisure activities, and coping

strategies are related to academic performance. We hypothesized that: a) Students with higher playfulness tendencies will use more adaptive coping skills; b) Students with higher playfulness tendencies will have lower levels of anxiety and higher GPAs; c) Students with higher playfulness tendencies will report higher leisure motivation; and d) Students with higher leisure motivation will have higher GPAs.

Method

Here we report quantitative findings from a mixed-methods, cross-sectional study. This study was approved by the Institutional Review Board (IRB) through the Western IRB committee. Participants were recruited using convenience sampling. Program directors of entry-level graduate programs in occupational therapy (OT), physical therapy (PT), and speech-language pathology (SLP) were requested to distribute flyers containing the survey link to their students. The survey included the following measures: Demographic Questionnaire, Adult Coping Inventory, Beck Anxiety Inventory, Adult Playfulness Trait Scale, and Intrinsic Leisure Motivation Scale[a]. Upon completion of the survey, participants had the option to receive a $15 gift card. Data was collected through Qualtrics XM and imported to SPSS v. 28 for analysis ($p < 0.05$).

Results

One hundred and eight (108) students participated. Most were enrolled in either a master's or doctorate program in OT (54.8%) and were predominantly female (87.5%), Caucasian (73.1%), and single (90.4%). The internal consistency coefficients were satisfactory, and the data confirmed parametric assumptions. Academic performance was not associated with playfulness or leisure, but playful students were less likely to use coping skills ($r=-0.31$, $p < 0.01$) or report being anxious ($r=-0.26$, $p < 0.05$); they engaged more in leisure activities ($r=0.35$, $p < 0.01$). Additionally, students who had higher academic performance reported higher levels of anxiety ($r=0.23$, $p < 0.05$).

Conclusions and Recommendations

Having higher anxiety correlates with the desire to do well within academic responsibilities, which promotes better academic outcomes (Sevlever &

Rice, 2010). Playful individuals engage in more leisure activities leading to less anxiety. The latter may serve as protective factors that are more likely to enhance academic performance (Kim et al., 2021). Limitations include a lack of diversity in the participant population. Future research should broaden its scope to include a wider range of graduate students. These findings have implications for higher education, suggesting the need to develop student advisement and support services for health professions students that promote playfulness.

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aNote: Measures available upon request.

Overcoming Social Isolation: Effectiveness of the Healthy Aging Wellness Program

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Introduction

Older adults are at a heightened risk for social isolation and loneliness, which have both been associated with a higher risk of depression and a decline in health that can result in increased mortality (Stokes et al., 2021). Older adults require interventions that promote healthy aging to mitigate this risk and that reflect their desire to age in place by being inclusive of community-dwelling older adults (Fausset et al., 2011). Yoga, mindfulness, and social activities are effective in enhancing physical and mental health outcomes for older adults, whether provided through online or in-person delivery (Adams et al., 2019; Reangsing et al., 2021; Sampath et al., 2022).

There is currently a research gap in examining both virtual and in-person delivery methods inclusive of community-dwelling older adults, while also incorporating a combination of yoga, mindfulness, and social practices to enhance hope and well-being. This study compared the impact of an eight-week Healthy Aging and Wellness (HAW) group-based program delivered online and in-person to improve hope and well-being in community-dwelling older adults.

Method

An IRB-approved, mixed-methods, pre- and post- nonrandomized, two-group design study with convenience sampling methods. Inclusion criteria: being 65 or older, fluency in English, being independent in daily living tasks, residing in a community, and being able to maintain upright standing. The online group and the onsite group at a senior center were delivered to in a group format following a standardized protocol with fidelity. Outcome measures included the Integrative Hope Scale (IHS; Schrank et al., 2010) and Personal Wellbeing Index (PWI; Cummins & Lau, 2003) as well as an open-ended post program interview.

Results

Fully 114 participants were screened for eligibility, of which 22 were found eligible (online group n=8; in-person n=14). Most participants were female, Caucasian, lived alone at home, aged 65 to 86 (M=74.8, SD±6.4). The HAW was delivered with high fidelity. No significant differences were found between groups or within groups in both sense of hope and wellbeing. Qualitative findings show that participants were satisfied with the program content, structure, and delivery, and that they expressed improvements in both their mental and physical well-being.

Table 1

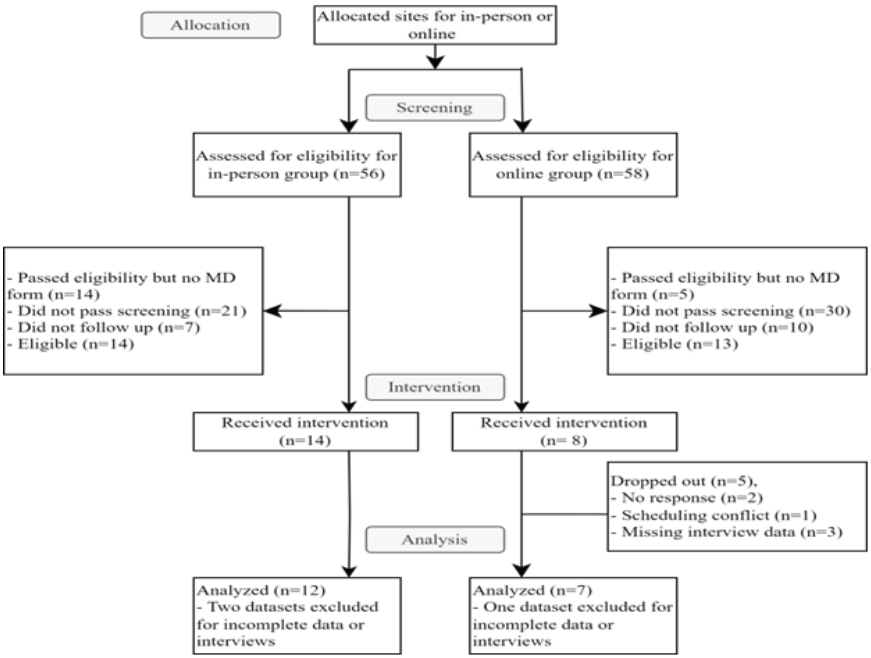
Within Groups Differences in Sense of Hope and Wellbeing

	Pre-test M, SD	Post-test M, SD	Z, p
In-Person[a] Hope	106.7 (14.1)	103.7 (16.1)	31.5, p>0.05
Online[b] Hope	107.1 (21.4)	110.3 (20.1)	21, p>0.05
In-Person[a] Wellbeing	69.8 (6.60)	70.1 (11.8)	34.5, p>0.05
Online[b] Wellbeing	70.9 (10.6)	73.7 (4.4)	14, p>0.05

Note. In-person[a] n=14, online[b] n=8

Figure 1

Selection and Screening for Eligibility



Conclusions and Recommendations

This study is the first to compare both modes of delivery and found that the HAW program has the potential to reach community-dwelling older adults needs and support aging in place. This sample had high pretest hope and

wellbeing scores compared to other samples, which may have impacted the results. Due to sample size limitations, we recommend providing this program to a large, more diverse group.

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Impact of Migraine Disability on Occupational Roles

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Introduction

Approximately 14.4% of the global population in 2016 experienced the impacts of migraine, the second-leading specific cause of disability (Burch et al., 2019). Migraine significantly impacts work productivity, with individuals reporting reduced capacity for 25% of their workdays, exacerbating economic burdens in low socioeconomic populations (Cooper et al., 2020). Migraine also strains social relationships and hinders engagement in occupations, or meaningful daily activities that occupy time; this result can exacerbate psychological distress. The effects of migraine are well documented, and so are the positive outcomes that occupational therapy (OT) can have on individuals who suffer from chronic pain conditions (Sahai-Srivastava et al., 2017), but OT literature has not yet explored how migraine affects overall daily function. With an individual's life roles being heavily influenced by their occupations (AOTA, 2020), examining the link between occupational roles and migraine disability would help bridge a major literature gap in this area. Through the Role Checklist Version 3 (RCv3) (Scott, 2019) and the Migraine-Specific Quality-of-Life Questionnaire (MSQ) v 2.1 (GSK, 1998), this research study sought to evaluate the relationship between occupational roles and migraine disability.

Methods

This quantitative, cross-sectional, clinic-based study was a secondary analysis of baseline data from a single-arm clinical trial evaluating remote Behavioral Migraine Management (BMM) migraine prevention (NCT03982316 on clinicaltrials.gov) with Einstein IRB approval (2019-10345). Inclusion criteria consisted of: a) physician diagnosis of migraine; b) current self-reported symptoms meeting the International Classification for Headache Disorders-3 (ICHD-3) criteria for migraine; c) self-reported at least 4 headache days per month, with at least one day without headache; d) aged 18–65; e) can read English; and f) capacity to consent. Exclusion criteria consisted of: a) psychiatric illness that may interfere with study participation; or b) probable medication overuse headache. Participants were recruited via convenience sampling from a headache center in New York City following provider referral; recruitment took place over two months, occurring on a rolling basis. Three participants were screened three times over 6 weeks to ensure eligibility and interest. Intake survey began with demographics collection, followed by the MSQ measuring quality of life in people with migraine and RCv3 measuring a person's participation levels, satisfaction with that participation, and reasons for non-participation. Participants provided all data through an intake screener and electronic surveys by the REDCap system. After data collection, sample characteristics for both measures were described using medians and interquartile ranges (IQR). Demographics were reported and the relationship between the two measures was visually depicted.

Results

Sample consisted of three female participants who identified as black or African American, white, or more than one race. The mean age was 40.67, *sd*=4.50 and mean headache days per month was 10.67, *sd*= 1.87. Higher MSQ scores indicated higher levels of migraine disability; lower RCv3 scores indicated lower levels of occupational performance-based role satisfaction.

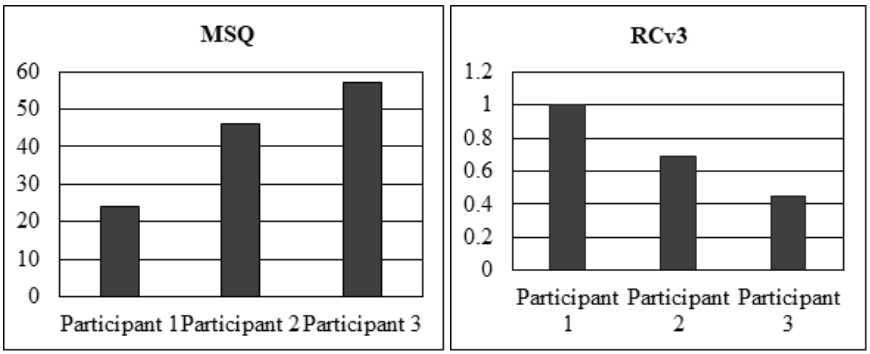
Table 1

Sample Characteristics

Sample Characteristics	n	%	M	SD
Gender				
Males	0	0		
Females	3	100		
Race				
Black or African American	1	33		
White	1	33		
More than one race	1	33		
Age			40.67	4.50
Headache days per month			10.67	1.87

Figure 1

Measure Visuals



Conclusion and Recommendations

Based on this study's results, we may be able to infer that higher levels of migraine disability can potentially be associated with lower occupational role satisfaction and performance. This study supports the idea that OT measures and frameworks may capture and address migraine interference with occupational roles and general function by looking at defining aspects of an individual, such as their specific occupational roles—a way that is yet to be explored within migraine literature. There were a few limitations with this study, one being the small sample size, which prevented the use of

any statistical tests. Additionally, only baseline data was collected due to time constraints. Future occupational therapists should consider evaluating the impact of migraine on occupations and roles.

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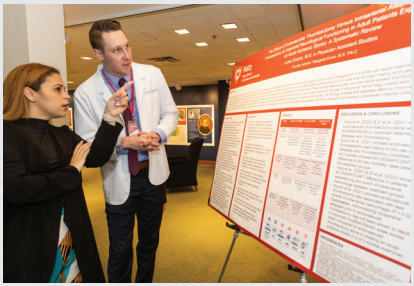
Physician Assistant Studies



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The Effects of Endovascular Thrombectomy Versus Intra-arterial Alteplase Plus Thrombectomy on Improved Neurological Functioning in Adult Patients Experiencing an Acute Ischemic Stroke: A Systematic Review

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Introduction

Large vessel occlusion strokes are a medical emergency and can result in life altering complications and even death if treatment is not prompt and effective. Endovascular thrombectomy has been the treatment of choice for such events, but infusions of alteplase prior to endovascular thrombectomy have been shown to be effective in achieving reperfusion prior to surgical interventions (LeCouffe et al., 2021). Achieving early reperfusion would be thought to lead to better neurological and functional outcomes after endovascular thrombectomy, however, alteplase and the administration of other intraarterial thrombolytic agents have been associated with larger rates of intracranial hemorrhages and other bleeding complications (Suzuki et al., 2019). Alteplase is a fibrinolytic agent that converts plasminogen to plasmin, leading to the lysis of fibrin and fibrinogen (Reed et al., 2023). This conversion helps dissolve the clot causing the large vessel occlusive stroke, but its location of action is not specific and can work throughout the body. A major adverse effect of fibrinolytic agents like alteplase is bleeding, angioedema, anaphylaxis, and fever (Reed et al., 2023).

The side effects and risks associated with using intraarterial thrombolytics prior to endovascular thrombectomy in treating large vessel occlusions makes the medical world question the need. The modified Rankin scale is the most widely accepted scale in assessing neurological function following an acute stroke (Saver et al. 2021). Scores range from 0 to 6, with 0 meaning no disability and 6 meaning death. LeCouffe et al. 2021 found treatment with endovascular thrombectomy and alteplase did not lead to significant improvements in modified Rankin Scale scores when compared to thrombectomy alone. In this systemic review, neurological outcomes using the modified Rankin scale are compared in adult patients who experienced an acute ischemic stroke and underwent endovascular thrombectomy treatment alone versus the administration of alteplase prior to endovascular thrombectomy.

Methods

A literature review of scholarly articles published from 2013–2023 was performed to evaluate the effectiveness of alteplase administration in improving neurological outcomes when given before adult patients (>18 years old) underwent endovascular thrombectomy following an acute ischemic stroke. The intervention assessed was endovascular thrombectomy with or without alteplase administration before surgery. The primary endpoint evaluated was an improved modified Rankin scale score. Additional outcomes observed were mortality rate and bleeding complications. Data was collected using electronic databases such as Medline-PubMed with search terms like acute ischemic stroke, alteplase, and acute ischemic stroke surgery.

Results

Table 1

Summary of Selected Studies

Study	Design	Population	Modified Rankin Scale Scores	Mortality Rate	Bleeding Complication
Yang et al. (2020)	Randomized Control Trial	656 adult patients who experienced an acute ischemic stroke in China	Modified Rankin Scale Odds Ratio between 2 groups was 1.07 (P = 0.04) (noninferior)*	90-day Mortality Rate Risk Ratio 0.94 (P = 0.71)	Symptomatic Intracranial Hemorrhage Risk Ratio 0.70 (P = 0.30)
Zi et al. (2021)	Randomized Control Trial	234 adult patients who experienced an acute occlusion of intracranial internal carotid artery in China	Modified Rankin Scale unadjusted difference 7.7% (P = 0.003) (noninferior)*	90-day Mortality Rate Difference (17.2% vs 17.8%	Any Intracranial Hemorrhage Event Risk (21.7% vs 32.5%)
Suzuki et al. (2021)	Randomized Control Trial	204 adult patients who experienced either an internal carotid or M1 occlusion in Japan	Modified Rankin Scale (difference 2.1%) (P = 0.18) (inferior)*	90-day Mortality Rate was 8% and 9% (P > 0.99)	Any Intracranial Hemorrhage Event was 34 (33.7%) and 52 (50.5%) (P = 0.02)

Conclusion and Recommendations

In adult patients who experienced an acute ischemic stroke, the results show treatment with endovascular thrombectomy alone was noninferior to treatment with alteplase prior to endovascular thrombectomy regarding improved neurological outcomes using the modified Rankin scale to assess at 90 days post-operation. Yang et al. (2020) found the common odds ratio between each treatment group was above their prespecified odds ratio of 0.8, proving that neither treatment group was inferior to the other (1.07 (95% confidence interval (CI), 0.81 to 1.40; P = 0.04)). Zi et al. (2021) found similar results showing the lower boundary of the confidence interval of -5.1% was greater than the noninferiority margin set at -10%, proving that neither treatment was inferior to the other (difference, 7.7%, 1-sided 97.5% CI, -5.1% to ∞, P for noninferiority = 0.003). Suzuki et al. (2021) also found no signifi-

cant difference in improved neurological functioning when comparing both treatments (difference 2.1% [1 sided 97.5% CI, -11.4% to ∞]; odds ratio, 1.09 [1 sided 97.5% CI, 0.63 to ∞]; 1 sided noninferiority P = 0.18). Across all 3 of these studies, 90-day mortality rates and number of intracranial hemorrhagic events were lower in the thrombectomy alone treatment group.

These findings bring the previously accepted treatment protocol of using alteplase prior to thrombectomy if the patient's symptoms began within 4.5 hours. Yang et al. (2020), Zi et al. (2021), and Suzuki et al. (2021) used a 1:1 randomizing ratio which helps to eliminate provider bias, and all had strict inclusion criteria like a pre-stroke modified Rankin scale score less than or equal to 2 that helped make the study populations similar when comparing results. However, all three studies looked at using alteplase prior to thrombectomy, rather than the newly adopted protocol of Tenecteplase that has been shown to have less adverse effects. Using Tenecteplase rather than alteplase could have yielded more pertinent results and possibly different primary and secondary outcomes. Future studies with a larger, more diverse sample size and up to date thrombolytics protocols will provide more significant results that would be more applicable to clinical practice. In summary, the use of alteplase prior to thrombectomy versus the use of thrombectomy alone in the setting of acute stroke treatment was not found to be superior and could lead to complications post-treatment.

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A Systematic Review of the Literature on the Best Course of Treatment in Patients with Iron Deficiency Anemia with Active Helicobacter Pylori Infections

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Introduction

Iron Deficiency Anemia (IDA) is the most common nutrient deficiency in the world (Tanous et al., 2021). The most common cause of IDA worldwide are chronic gastrointestinal bleeds, which are primarily caused by the pathogen Helicobacter Pylori. H.pylori may lead to micro bleeding and may affect iron uptake, depleting iron stores in persons with IDA (Nashaat et al., 2013). The mechanisms underlying the association between IDA and H.pylori are not completely understood. Some research mentions that a mechanism for H.pylori to cause IDA is by competing for dietary iron (Nashaat et al., 2013), while other research reveals that decreased iron absorption is caused by gastric hypochloridia, leading to the reduction of the non-heme iron from their ferric to ferrous form (Demerdash et al., 2018). The acid secretion is said to normalize after the eradication of H.pylori (Demerdash et al., 2018). Risk factors associated with an increased risk of acquiring an H. pylori infection are unsatisfactory hygiene, dense population, intake of undercooked food from streets, impure water availability, smoking and smokeless tobacco (Kishore et al., 2021).

The aim of this study was to investigate if the eradication of H.pylori is more efficacious in treating IDA than using iron supplementation alone in adult patients with an active H.pylori infection. A series of studies were reviewed to explore the different types of treatment plans in patients with IDA and active H.pylori infections.

Methods

A review of the literature was conducted to evaluate the effectiveness of H.pylori eradication in reversing IDA in adults who have tested positive for H.pylori versus the administration of iron supplementation alone. The intervention assessed was the eradication of H.pylori versus iron supplementation only. The primary end points assessed were hemoglobin level, serum iron, and serum ferritin. The data was collected through a literature search using multiple electronic databases available through the Yeshiva University library. The databases used for this search were Medline-PubMed and Google Scholar. The following search terms were used in Google Scholar: iron supplementation in patients with H.pylori, H.pylori with IDA treatment. The following search terms were used in Medline-PubMed: H.pylori eradication iron deficiency. Experimental studies, case-control studies, and prospective therapeutic studies were included for review and analysis. Literature search was limited to peer-reviewed journal articles published within the last 10 years (2013–2023).

Results

Table 1

Summary of Selected Studies

Study	Design	Population	Results
Nashaat et al. (2013)	Experimental Study	100 pregnant patients, 10-14 weeks gestation who have IDA, 50 of them with H.pylori infection	The response to iron supplementation in patients without H.pylori was better than in patients with infection. Also, there is a higher response to iron therapy after H. pylori eradication.
Demerdash et al. (2018)	Randomized Cohort Control	104 Egyptian patients with unexplained IDA, 60 with H.pylori infection	Patients who eradicated H.pylori infection and used iron supplementation together had a more significant rise in IDA parameters than iron supplementation alone.
Shalta et al. (2016)	Prospective Therapeutic Study	36 patients from Saudi Arabia with IDA and tested positive for H.pylori infection	The eradication of H.pylori in addition to iron supplementation was associated with a faster and better recovery from IDA as compared to eradication therapy without iron supplementation.

Conclusion and Recommendations

This study found that the eradication of H.pylori infection is more efficacious in the recovery of IDA than the use of iron supplementation alone. Future research can examine the resistance of H.pylori in some patients, which may hinder the management of IDA. New research can also look at the correlation of IDA and H.pylori following the new standard of care, Bismuth quadruple therapy (Proton pump inhibitor, tetracycline, metronidazole, and a bismuth salt). There may be more significant improvements in IDA parameters after eradication, and it might even expedite the recovery from IDA. Medical providers should look for possible H.pylori infections in patients with unexplained IDA because it has been proven to play a primary role in IDA.

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Comparing the Efficacy of Immediate Delivery and Expectant Management in Pregnant Women with Preeclampsia: A Systematic Review of the Literature

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Introduction

Preeclampsia is a serious complication of pregnancy characterized by high blood pressure that can result in end-organ damage, seizures and death in the pregnant woman. Currently, there is no clear consensus on the best management practice for pregnant women between 34–37 weeks with preeclampsia. While the best treatment option is up for debate, one thing is clear; the only definitive management is delivery (Chatzakis, 2021). Premature delivery at 34 weeks increases the risk of the infant being born with breathing problems, immature lungs, and cardiac problems, among many others. Conversely, waiting to deliver until 37 weeks increases the risk of the mother having complications of preeclampsia, including eclampsia, cardiovascular disease and death. Current standards favor expectant management over early delivery (Broekhuijsen, 2015). This treatment method allows the fetus more time to develop inside the womb while the pregnant mother is carefully monitored for signs of complications. The aim of this systematic review was to determine which treatment option for preeclampsia would result in the best outcomes for both mother and baby.

Strategy

A literature review was conducted to compare the outcomes between immediate induction of labor and expectant management in pregnant women diagnosed with preeclampsia. The primary outcome evaluated was fetal and maternal morbidity, and the secondary outcomes included length of NICU stay, APGAR score, and rates of neonatal respiratory distress syndrome. Articles included in the review were found on Medline-PubMed and ScienceDirect and were accessed through the Yeshiva University library electronic databases. Randomized controlled trials and two meta-analyses fit the inclusion criteria and were used in the review. The search was restricted to peer-reviewed journal articles published within the last 10 years (2013–2023). Included in this review are randomized controlled trials where pregnant women diagnosed with preeclampsia were placed in either the immediate delivery treatment group or the expectant management group. Both fetal and maternal outcomes were observed. Outcomes were analyzed using significant p-values of 0.05 and below, and a positive risk ratio of 1.0 and above.

Findings

Primary adverse maternal outcomes included any maternal morbidity, while adverse fetal outcomes included NICU admission or respiratory distress syndrome. From all the randomized controlled trials, it was found that there were more adverse fetal outcomes in the immediate delivery group but increased adverse maternal outcomes in the expectant management group. Regarding fetal outcomes, the results were all statistically significant in favor of expectant management, with p-values of 0.0034 (Chapell, 2019), 0.0053 (Broekhuijsen, 2015), and a risk ratio of 2.3 (Chatzakis, 2021). Regarding maternal outcomes, while all trials favored immediate delivery, only one trial had statistically significant results. That trial found a p-value of 0.005 (Chapell 2019), while the other trials had a p-value of 0.069 (Broekhuijsen, 2015) and a risk ratio of 0.86 (Chatzakis, 2021).

Conclusion and Recommendations

The results showed that while maternal outcomes are affected by treatment option, not all results were significant. On the other hand, every trial found

a significant advantage to expectant management over immediate delivery regarding fetal outcomes. These findings indicate that fetal outcomes are much more impacted by treatment option than maternal outcomes, and expectant management is the slightly safer way to go.

While this research found expectant management to be more efficacious, it is ultimately up to each patient to decide what the best choice is for them. As providers, it is our job to utilize evidence-based practice to help guide the patient's decision. We should present the patient with all the relevant information to make a fully informed decision for themselves and their baby. Then, it is our responsibility to do all we can for the patient and to be a source of comfort and support through this difficult time.

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Systematic Review of Macrosomia Occurrence During Pregnancies of Patients with Diabetes Using Continuous Glucose Monitoring versus Self-Blood Checks

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Introduction

The number of pregnant women who have diabetes is on the rise due to the increase of diabetes worldwide. These pregnancies are classified as "high risk" due to maternal hyperglycemia, which may cause macrosomia (50%, most common), preterm birth, birth defects, and stillbirth (Murphy et al, 2008). Macrosomia causes high risk of delivery complications. Immediate adverse effects for infants may include shoulder dystocia and neonatal hypoglycemia. Infant's adverse effects later in life may include obesity, diabetes, and cardiovascular disease (Davis et al, 2023).

Diabetes management before continuous glucose monitoring (CGM) included self-blood glucose checks and HbA1c every 6 months. The CGM updates glucose levels every 5 minutes. It allows for informed dietary and activity-based decisions and helps keep glucose "in-range" (Danne et al, 2017). This study aimed to determine if CGM can lower the risk of macrosomia in pregnant women with diabetes. The primary outcome observed was birth weight. The secondary outcomes observed were risk of macrosomia, the mother's glycemic control, and neonatal outcomes.

Method

A review of the literature was performed to evaluate the birth weight of infants born from mothers with diabetes using a continuous glucose monitoring (CGM) system in comparison to self-blood sugar checks. Data was collected through literature search using the electronic database Medline-PubMed. The following search terms were used: continuous glucose monitoring and pregnancy, continuous glucose monitoring and macrosomia, continuous glucose monitoring and birth weight. Only clinical trials were included for review and analysis. The literature search was limited to only human based clinical trials and peer-reviewed journal articles within the last 15 years (2008–2023).

Findings

Table 1

Summary of Results from Murphy, et al. (2008)

Study 1: Murphy, et al. (2008)

Study Type	Population	Results
Prospective, open label randomized controlled trial	71 women, Type 1 or type 2 diabetes, Ages 16–45 years	Decreased average fetal birth weights (p=0.05) Decreased risk of macrosomia through calculation of odds ratio being 0.36 (p=0.05)

Table 2

Summary of Results from Feig, et al. (2017)

Study 2: Feig, et al. (2017)

Study Type	Population	Results
Multicenter, open label randomized controlled trial	325 women (215 pregnant, 110 planning pregnancy), Type 1 diabetes Ages 18–40 years	Lower odds ratio of LGA infants (p=0.021), fewer neonatal intensive care admissions > 24 hours (p=0.0157), fewer neonatal hypoglycemic events (p=0.0250), and shorter neonatal length of hospital stay (p=0.0091)

Table 3

Summary of Results from Scott, et al. (2020)

Study 3: Scott et al. (2020)

Study Type	Population	Results
Randomized controlled trial	200 pregnant women, Type 1 diabetes Ages 18–40 years	Population of More time in range ($p<0.05$), lower average glucose in the second and third trimesters for non-LGA infants ($p<0.05$), both "daytime" and "nighttime" glucose levels were lower for the second trimester non-LGA infants ($p<0.05$)

Conclusion and Recommendations

Murphy et al., (2008) demonstrated that CGM usage caused decreased HbA1c measurements, average fetal birth weight, and median birth weight percentiles. Feig et al., (2017) showed that CGM users had a slight decrease in their HbA1c but a considerable increase in their "time in range." Also, neonatal adverse events were less likely to occur for CGM users. Scott et al., (2020) showed CGM users have lower "daytime" levels. CGMs can greatly impact a mother's health as well as their baby's. Increasing mother's "time in range" decreases the risk of macrosomia and should be recommended to all women with diabetes that are either pregnant or planning a pregnancy.

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Speech-Language Pathology

Rachel Eliav

Rachel Horwitz

Enhancing Communication Skills in Children with ASD: The Role of Active Parental Participation in Speech Therapy with Behavioral Strategies

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Introduction

Communication challenges in children with autism spectrum disorder (ASD) necessitate specialized training programs and active parental involvement to improve social interactions and well-being (Killmeyer & Kaczmarek, 2017). Integrating evidence-based speech therapy techniques and tailored behavioral strategies is crucial for enhancing communication skills and promoting positive behavior in children with ASD (Heath et al., 2020). This study's goal was to provide parents of children with ASD beneficial information and resources to enhance their parental training in behavior management strategies, ultimately improving speech therapy outcomes. This was accomplished by exploring the role of active parental involvement and addressing the communication challenges of children with ASD. The study examined evidence-based speech-language pathology techniques and targeted behavioral strategies that prioritize individualized care and holistic development.

Strategy

A literature review was conducted to examine evidence-based speech therapy techniques and targeted behavioral strategies that prioritize individu-

alized care and holistic development for children with ASD. Research shows that involving parents and teachers in programs like Social Skills Training (SST), Parent Training (PT), and Cooperative Parent-Mediated Therapy (CPMT) enhances social, communication, and daily living skills in children with autism spectrum disorder (ASD) and reduces ASD symptoms.

Outcomes

Based on the findings, an acronym was created for parents to utilize in therapy sessions and home environments: VOICE (Figure 1). This approach offers a comprehensive guide for enhancing the communication and social skills of children with ASD, fostering their development across all dimensions of life.

- Visuals: Visual aids were effective in helping children with ASD understand daily routines, allowing them to prepare for upcoming changes in their schedule for an easier transition between activities (Matsumura et al., 2022; Otero et al., 2015).
- Optimizing the home environment: Cheng et al. (2022) identified the importance for parents to make changes in their home environment, adapting to their child's specific needs and creating a supportive and conducive environment for their skill development. Naidoo & Govender (2022), mentioned various adaptations such as having a clear structure and routine, calming sensory lights, minimizing noise distractions, respecting their space, keeping things organized, using neutral colors and small patterns, and locking away hazardous items.
- Interactive play: Play therapy involving pretend play, collaborative games, floor time, or sensory activities was reported to be effective in communication and social skill development (Dekker et al., 2014; Naidoo & Govender, 2022). Acitivies included reading books, painting, and playing with mud or slime. Valeri et al. (2019) reported that by engaging in play therapy, children with ASD could participate in back-and-forth interactions that helped them build communication and social skills and enhanced their ability to engage in new activities.

- Communication boards: Heath et al. (2020) demonstrated the benefits of communication boards as aids that enabled children with ASD to communicate non-verbally and express their needs, thoughts, and feelings by selecting images representing the objects or actions they wanted.
- Encouragement: Chung et al. (2024) emphasized the importance of positive reinforcement in recognizing and rewarding positive behaviors as it motivates, nurtures, and promotes long-term behavioral improvements in children with ASD.

Figure 1

Measure Visuals

Voice is an acronym created by the author for effective strategies parents can utilize in therapy sessions and home environments. This approach offers a comprehensive guide for enhancing the communication and social skills of children with ASD. Structured parent training programs like VOICE are crucial for empowering parents to support their child's communication and social skills effectively. Continuous parent education ensures ongoing support in reinforcing skills and managing challenging behaviors.

Conclusion and Recommendations

Active parental involvement in speech therapy and integration of behavioral strategies significantly enhance communication skills and language proficiency in children with ASD (Heath et al., 2020; Cheng et al., 2022; Chung et al., 2024). Parental engagement facilitates language development through everyday activities, while strategies such as social skills training enable children with ASD to better express themselves and engage with others.

Clinicians should prioritize active parental involvement in the child's treatment, teaching them effective strategies for better outcomes among children with ASD and implementing evidence-based behavioral strategies to improve communication and social skills. Future research should focus on improving behavioral strategies and parent training programs to maximize social and communication skills development outcomes in children with ASD.

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Systematic Review of the Impact of Professional Development/Education for Paraprofessionals to Learn Essential Skills to Support Elementary School-Age Children with High-Tech Touch Screen AAC Devices

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Introduction

This study explores the vital role of Augmentative and Alternative Communication (AAC) devices in supporting elementary school-aged children with speech and language impairments (Calculator, 2009). AAC devices refer to a wide range of technologies and techniques designed to support expressive and receptive communication for individuals with various needs. Advancements in high-tech touch screen AAC devices like Proloquo2Go and Predictable™ offer particularly innovative solutions (American Speech-Language-Hearing Association, 2009; Elsahar et al., 2019), and paraprofessionals play a crucial role in supporting adoption of these devices in educational settings. However, there is a persistent gap in paraprofessionals' proficiency in using AAC devices and in implementing evidence-based strategies (Binger et al., 2012; Moorcroft et al., 2019).

This study aimed to explore the impact of tailored professional development programs for paraprofessionals, focused on paraprofessionals acquiring the essential skills to support children with AAC devices effectively. By evaluating current training initiatives and outcomes, the study addresses critical gaps in knowledge and practice. Through a comprehensive litera-

ture review, tailored training modules and strategies were developed, contributing to inclusive educational practices and enhancing communication outcomes for children with complex communication needs.

Strategy

Qualitative data collection involved a systematic review of peer-reviewed articles across databases like AshaWire, EBSCO, and Google Scholar, resulting in the selection of eleven articles meeting predefined criteria. Thematic analysis was employed to identify recurring patterns and key concepts through precise coding and iterative refinement. This qualitative synthesis aligns with research objectives, enabling a comprehensive examination of diverse perspectives on paraprofessional support for AAC device users. It aids in identifying gaps and informing recommendations for training program enhancement. Potential limitations include publication and sampling biases, as well as contextual factors influencing synthesized findings, necessitating careful interpretation.

Findings

Studies conducted by Chavers et al. (2021) and Kleinert et al. (2023) highlight the potential effectiveness of AAC interventions in enhancing communication skills among elementary-aged students with diverse needs. Chavers et al. demonstrated through a multiple-baseline design that AAC interventions utilizing speech-generating devices (SGDs) have a strong effect on multistep requesting, and a medium effect on generic small talk in children with severe autism spectrum disorder. Kleinert et al.'s (2023) systematic review identified positive outcomes in inclusive settings following AAC interventions, emphasizing successful methods such as peer-mediated strategies and collaboration. However, Andzik et al.'s (2016) findings indicated a significant lack of paraprofessional education on AAC device use, highlighting challenges in accessing essential training and resources. Furthermore, Brock and Anderson (2021) proposed methods to enhance paraprofessional training effectiveness, emphasizing performance feedback and innovative training modalities such as online sessions. Similarly, Kramlich (2012), stressed the importance of on-site, in-service training and the necessity of AAC experts within school districts to provide comprehensive training to educators.

Conclusion and Recommendations

This study emphasized the urgent need for comprehensive AAC training for paraprofessionals, who currently lack resources and support despite AAC devices' proven effectiveness in improving communication outcomes for students. Addressing this deficiency is crucial for fostering inclusive educational environments and ensuring equal opportunities for all students. Insights from multiple studies highlight promising AAC intervention strategies but also underscore challenges in evaluating intervention effectiveness. Future research and implementation efforts should focus on improving training accessibility, refining AAC intervention approaches, and evaluating student outcomes in inclusive settings to enhance educational experiences.

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