

# Proceedings of the Katz School's 2025 Symposium on Science, Technology and Health

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

Katz School of Science and Health  
New York City  
May 15, 2025



**Katz**

Katz School  
of Science and Health

Proceedings from the Katz School's 2025 Symposium on Science,  
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Edited by Marissa Barrera, Sofia Binioris, Rana Khan,  
and Amiya Waldman-Levi

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## Foreword

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The 27 extended abstracts published in these proceedings—originally presented at the Katz School’s 2025 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 2025 symposium was held in New York City on May 15, 2025, 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
- Amiya Waldman-Levi, Ph.D., OTR/L, FAOTA, Formerly Clinical Associate Professor and Director of Scholarship and Research of Occupational Therapy

The symposium highlighted projects across disciplines—from artificial intelligence and biotechnology to occupational therapy and digital marketing—demonstrating the Katz School’s commitment to advancing knowledge and preparing students to lead in a rapidly evolving world. This year’s stand-

out projects included AI-powered tools to improve lung cancer detection, intergenerational trauma on children’s development and how diet affects diabetics, as well as cross-disciplinary work to facilitate children’s development through play and to create a rare disease database to improve diagnosis and treatment.

Four projects were recognized for their exceptional scholarship:

- **Outstanding Original Research in STEM:** Tara Ghafoori and Rupali Khane (M.S. in Biotechnology Management and Entrepreneurship) for their study of SUMO proteins and spermatogenesis in mice and their implications for male infertility.
- **Outstanding R&D in STEM:** Naveen Khetarpal, Dandan Wang and Ebenezer Ajao (M.S. in Biotechnology Management and Entrepreneurship) and Prashant Soni (M.S. in Artificial Intelligence) for their work developing an information hub for innovations in rare diseases.
- **Impact through Literature Analysis in Health:** Sharon Matalon (M.S. in Speech-Language Pathology), whose research explored the effectiveness of group therapy for children with Autism.
- **Outstanding Original Research in Health:** Bella Chilczuk (Occupational Therapy Doctorate) for her work on a Tier-1, strength-based program to enhance parent-child play interactions.

Symposium attendees also voted to give Joy Awoleye, Laticbe Elijah and Christine Macharia (M.S. in Cybersecurity) the “People’s Choice” award for their work to develop a unified and secure online platform for university student associations and alumni.

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 Albert Einstein College of Medicine, Frezent Biological Solutions, Florida Gulf Coast University, Healers, Hilton NY Fashion District, NYU Langone Health, South Shore Neurologic Associates, Stonybrook University, and U.S. Department of Veteran Affairs. The scientific committee would also like to acknowledge David DeFusco, Denton Field, Ann Leary and Grace Morrison, as well as our graduate student volunteers for their invaluable contributions.

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## Message from the Dean

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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 2025 symposium—drawn from every one of the Katz School's STEM and Health Sciences graduate programs—exemplify our students' fulfillment of this mission.

Sincerely,

A handwritten signature in black ink that reads "Russo". The signature is fluid and cursive, with the first letter 'R' being particularly large and stylized.

**Paul Russo**

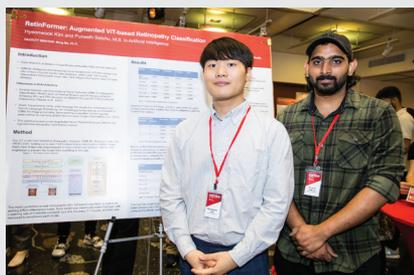
Paul Russo, Ph.D.

Dean, Katz School of Science and Health

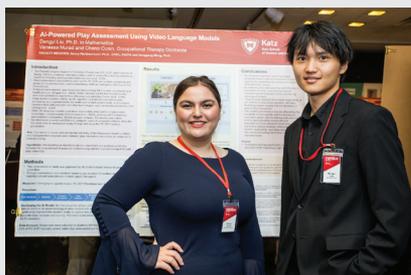
Vice Provost, Yeshiva University

Professor of Data Science and Information Systems

# Artificial Intelligence



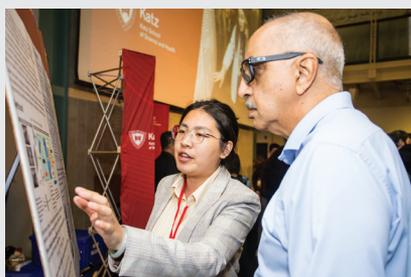
*Puneeth Batchu and Hyeonwook Kim*



*Chana Cunin and Dengyi Liu*



*Nikhil Deekonda*



*Jialu Li*



*Chengyi Liu*



*Shiman Zhang*

# RetinFormer: Augmented Vision Transformer-based Diabetic and Hypertensive Retinopathy Classification

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***Puneeth Batchu and Hyeonwook Kim***

M.S. in Artificial Intelligence

***Faculty Mentor***

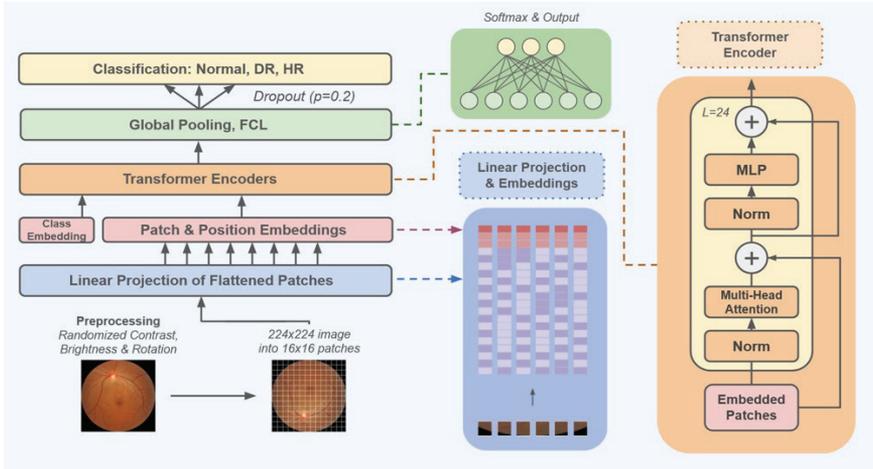
Ming Ma, Ph.D.

## **Introduction**

Diabetic retinopathy (DR) and hypertensive retinopathy (HR) are leading causes of preventable blindness. Yet, their early detection remains challenging in resource-limited settings due to reliance on specialized expertise and time-consuming diagnostic methods (Flaxel et al., 2020). While recent AI-based approaches, including convolutional neural networks (CNNs) and hybrid CNN-Transformer models, have improved retinopathy classification, limitations persist in generalizability across diverse populations and imaging conditions (Quelleg et al., 2017). Key questions remain: *How can AI models achieve robust, scalable classification of DR and HR without extensive domain-specific data? Can transformer-based architectures outperform existing methods in accuracy and adaptability?* This project aims to bridge this gap by proposing *RetinFormer*, a Vision Transformer (ViT)-based model enhanced with transfer learning and advanced data augmentation. By leveraging pre-trained knowledge of retinal pathologies and optimizing for varied imaging datasets, the study seeks to automate accurate classification of normal, DR, and HR cases, offering a scalable solution for early diagnosis in underserved regions.

## Method

**Figure 1**  
*The RetinFormer Pipeline*



As shown in Figure 1, the proposed method involves preprocessing fundus images with randomized brightness, contrast, and rotation to enhance data diversity and reduce overfitting. Processed images are split into patches and fed into the ViT model; each patch is linearly projected with additional patch, positional and class embeddings. That data is then processed by a series of transformer encoders, which uses multi-head self-attention to capture contextual relationships. This is followed by a global average pooling layer; an MLP head is used to classify the output into three categories: Normal, Diabetic Retinopathy, or Hypertensive Retinopathy. The model leverages transfer learning, initialized with weights pretrained on 1.6M unlabeled retinal images, and is trained using Adam optimizer with cross-entropy loss.

## Results

**Table 1**  
*Classification Performance Comparison*

<b>Model</b>	<b>Accuracy</b>	<b>Precision</b>	<b>F1-Score</b>	<b>AUC</b>
HDR-EfficientNet	0.8963	0.8983	0.8973	0.9548
ViTAEv2	0.9018	0.9013	0.9015	0.9646
ViT_b_16	0.9127	0.9168	0.9147	0.9847
ViT_b_32	0.9147	0.9165	0.9156	0.9814
ViT_l_32	0.9167	0.9165	0.9166	0.9784
<b>RetinFormer</b>	<b>0.9271</b>	<b>0.9270</b>	<b>0.9270</b>	<b>0.9866</b>

As reported above, the experiments evaluated the performance of transformer-based (RetinFormer, ViT\_l\_32, ViTAEv2, ViT\_b\_32) and CNN-based (HDREfficientNet) models for image classification. RetinFormer achieved the highest accuracy (92.71%), followed by ViT\_l\_32 (91.67%), while ViTAEv2 (90.18%) marginally outperformed HDREfficientNet. Testing accuracy and F1 scores for transformer models (e.g., RetinFormer) declined after initial epochs, suggesting overfitting. Class-specific metrics revealed instability in the "Normal" class (F1: 0.82 vs. 0.91–0.93 for pathological classes), likely due to dataset imbalance.

## Conclusions and Recommendations

This study demonstrates that deep learning models can significantly improve the automated diagnosis of diabetic and hypertensive retinopathy, achieving superior performance over existing benchmarks (e.g., HDR-EfficientNet, ViT variants) in classification accuracy, precision, and recall. The findings reinforce the value of transfer learning, data augmentation, and advanced optimizers in medical imaging, while highlighting challenges such as overfitting in transformer-based models on small datasets. These results advance the potential for AI-driven tools to enhance early detection, reduce diagnostic delays, and expand accessibility, particularly in resource-limited settings. Future work should focus on larger, diverse datasets, multimodal data integration (e.g., patient history), and improved model interpretability to foster clinical trust. This research contributes to the

broader effort to combat preventable blindness through scalable, AI-augmented healthcare solutions.

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# AI-Powered Play Assessment Using Video Language Models

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## ***Dengyi Liu***

Ph.D. in Mathematics

## ***Chana Cunin and Vanessa Murad***

Occupational Therapy Doctorate

## ***Faculty Mentors***

Amiya Waldman-Levi, PhD, OTR/L, FAOTA

Honggang Wang, Ph.D.

## **Introduction**

The Parent/Caregiver Support of Children’s Playfulness (PC-SCP; Waldman-Levi & Bundy, 2023) is a reliable and valid observation for identifying and supporting child development (Waldman-Levi et al., 2019). However, observation-based assessments like the PC-SCP can be time-consuming and prone to human error, bias, and inconsistency. Deep neural networks (DNN), a Machine Learning (ML) model that mimics brain information processing, is highly capable and superior for health-care-related assessments due to its ability to analyze complex input with precise detail that other technologies, such as tree-based models. (Zhang et al. 2024). We developed a combined DNN and computer vision AI-powered software to analyze joint play footage and apply the PC-SCP scoring procedures. Our aim is to create and validate the reliability of the AI-powered model to detect and track human behaviors accurately against manual scoring.

## Method

Through convenience and snowball sampling we recruited 38 mother-child dyads of neurotypical and neurodiverse children aged 1 through 6.). Eligible participants were mother or fathers with a child aged 1-6 with access to Zoom and an internet connection. These participants were then informed to complete the consent form and demographic questionnaire via Qualtrics. Data collection consisted of 10–15-minute parent-child play experiences recorded via Zoom in their natural environment. Graduate student research assistants utilized PC-SCP manual scoring to score each video, ensuring 20% inter-rate reliability (IRR). To accept our hypothesis, we trained deep neural network (DNN) models, including Qwen2.5VL (Bai et al., 2025), a large-scale multimodal vision–language model that integrates visual and textual understanding to perform tasks such as object recognition, OCR/text analysis in images, long-video comprehension, and interactive reasoning or tool usage. In our study, we adapted and fine-tuned Qwen2.5VL on domain-specific video data to enhance its ability to detect the parent/caregiver in each frame, robustly track their spatiotemporal trajectories across consecutive frames, and evaluate interactions according to the PC-SCP framework. Furthermore, we applied instruction tuning with domain-specific prompts to improve the model’s alignment with scoring criteria in PC-SCP, thereby enabling not only accurate caregiver detection but also the automatic assignment of meaningful interaction scores over the full video sequence. Manual scores were compared to the model for validation.

## Results

The collected sample included 38 English-speaking mothers, who reported being married and Caucasian (64%). Children’s average age was 3.15,  $SD=1.60$ , of which 54% were boys and 46% girls. 85% of the children have no established diagnosis while 15% have either attention deficit disorder or Autism. IRR was found acceptable (75%-100%).

In our tests, the fine-tuned Qwen-2.5-VL consistently outperformed other state-of-the-art Video LLMs on key metrics—accuracy, Cohen’s Kappa, and top-5 accuracy—though variability in video quality and a modest training set limit its cross-population generalizability.

Our results demonstrate that **Qwen2.5VL consistently outperforms other Video Large Language Models**, achieving the highest accuracy and top-5 accuracy across all metrics. In contrast, **InternVL and LLaMA3.2-Vision exhibit substantially lower performance**, highlighting the relative advantage of Qwen2.5VL in video understanding tasks.

## Conclusions and Recommendations

We present an automated parent–child interaction analysis approach leveraging fine-tuned video LLMs (e.g., Qwen2.5VL), which markedly enhances scoring accuracy and recall while sharply reducing reliance on time-consuming manual evaluations. Future research will focus on expanding dataset diversity, refining multimodal fusion architectures, and validating the system’s practical utility and robustness in real-world settings.

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# LungAware: AI Lung Cancer Detection App

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***Nikhil Deekonda***

M.S. in Artificial Intelligence

***Faculty Mentor***

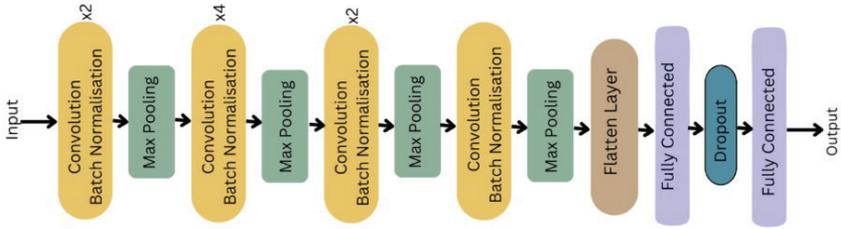
Youshan Zhang, Ph.D.

## **Introduction**

Artificial intelligence (AI), particularly deep learning, has revolutionized medical imaging by offering high diagnostic accuracy, often rivaling human experts in specialized tasks such as detecting cancerous lesions in CT scans (Lakhani & Sundaram, 2017). Lung cancer, the leading cause of cancer-related deaths globally, presents a critical need for early and accurate diagnosis to improve patient outcomes (Gill et al., 2007). However, the immense volume of imaging data and shortage of radiological expertise can delay diagnosis, especially in resource-limited settings (Wang et al., 2020). While convolutional neural networks (CNNs) have demonstrated strong performance in automated lesion detection (Shen et al., 2019), current solutions often lack accessibility and interpretability, hindering their real-world adoption. This study addresses these gaps by developing a mobile-based AI application that classifies lung CT scans into malignant, benign, or normal categories. The tool incorporates CNNs for lesion classification and integrates interpretability through Gradient-weighted Class Activation Mapping (Grad-CAM) (Selvaraju et al., 2017), which highlights regions influencing the model's decision, fostering clinical trust (Jha & Topol, 2021). To ensure input validity, a cosine similarity check with a threshold of 0.8 was integrated to reject irrelevant scans.

**Figure 1**

*Model architecture showing convolutional, normalization, pooling, and fully connected layers used for classifying lung CT scans.*



## Approach

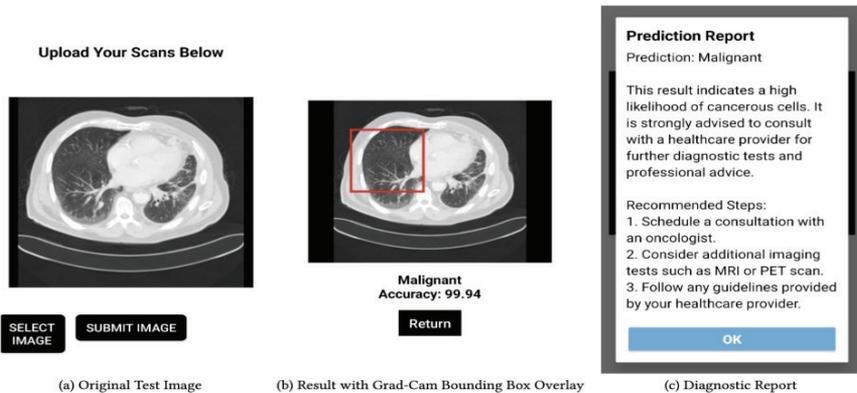
A custom convolutional neural network (CNN) was developed and deployed through a mobile application to classify lung CT scans into malignant, benign, or normal categories. The dataset used consisted of publicly available, pre-labeled CT scan images, which were resized to 224×224 pixels, normalized, and augmented with transformations such as rotation and scaling to improve generalization. The model architecture, illustrated in Figure 1, features multiple convolutional blocks with batch normalization and max-pooling layers, followed by a flattening operation, two fully connected layers, and a dropout layer for regularization. The final softmax layer outputs class probabilities. The model was trained using categorical cross-entropy loss and optimized with stochastic gradient descent (SGD) at a learning rate of 0.001. Performance was evaluated using accuracy, precision, recall, and F1-score on a held-out validation set. To enhance clinical interpretability, Gradient-weighted Class Activation Mapping (Grad-CAM) was used to overlay heatmaps on the input CT scans, indicating which regions influenced the model's decision. Additionally, a cosine similarity check with a threshold of 0.8 was integrated to ensure only valid lung CT images were accepted, guiding users to upload appropriate scans. The app was built using Android Studio and Xcode to support both Android and iOS devices, allowing users to input images, view predictions with Grad-CAM overlays, and download diagnostic reports. As only de-identified, open-access data were used, no IRB approval was required.

## Outcomes

The proposed CNN model was evaluated on the IQ-OTH/NCCD dataset, consisting of 300 test CT scans categorized as malignant, benign, or normal. The model achieved an overall classification accuracy of 99.4%, with precision, recall, and F1-scores exceeding 0.97 across all classes (malignant: F1 = 1.00, normal: F1 = 0.99, benign: F1 = 0.99), indicating strong and balanced performance. The model correctly classified nearly all test samples, with only two misclassifications observed. Grad-CAM visualizations demonstrated that the model's attention was focused on medically relevant regions, thereby supporting interpretability and aiding clinicians in verifying predictions (Figure 2). Additionally, performance comparison with recent state-of-the-art models on the same dataset showed that our model is competitive, achieving a higher overall balance of sensitivity (98.0%) and specificity (97.5%), closely rivaling advanced architectures such as Double-Layered CNNs and MENet.

**Figure 2**

*Application Input and Outputs with Report*



## Conclusions and Recommendations

This study presents a mobile-based lung cancer screening tool that leverages a custom convolutional neural network (CNN) and Grad-CAM interpretability to classify lung CT scans into malignant, benign, or normal categories with a high degree of accuracy (99.4%). The application demonstrated

strong performance across all key metrics on the IQ-OTH/NCCD dataset and showed effective visual localization of disease-relevant regions through Grad-CAM overlays, contributing both diagnostic precision and transparency to support clinical decision-making. The inclusion of cosine similarity filtering enhances input quality control, making the app more reliable and user-friendly, particularly in low-resource settings. Future work will focus on expanding dataset diversity, incorporating AI-generated diagnostic reports, optimizing inference time for edge devices, and ensuring compliance with medical data standards.

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# DX-Mamba: Exploring State Space Model for Dog X-ray Report Generation

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## ***Jialu Li***

M.S. in Artificial Intelligence

## ***Faculty Mentor***

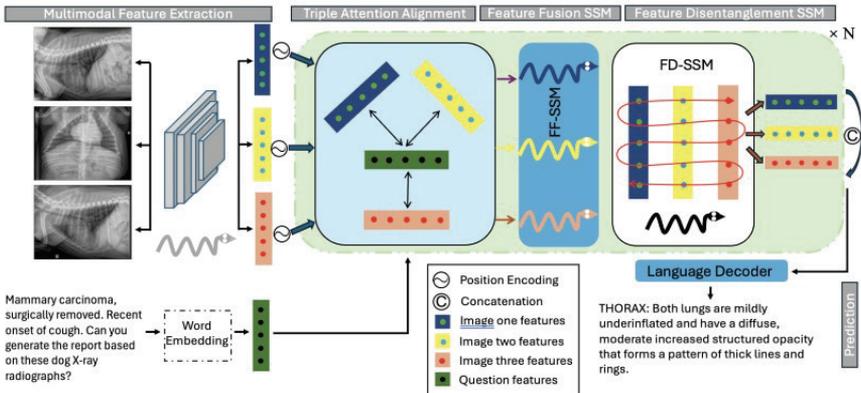
Youshan Zhang, Ph.D.

## **Introduction**

Thoracic diseases are a common cause of dog death. As more people own pets, the veterinary medicine field has focused on technologies that aid in the early and accurate detection of canine thoracic diseases. Manually diagnosing and generating reports from X-rays is time-consuming and requires expertise. In recent years, deep learning models such as convolutional neural networks (CNNs) (Shin et al., 2016a), recurrent neural networks (RNNs), Long Short Term Memory (LSTM) (Xue et al., 2018), transformers (Wang et al., 2023), and generative adversarial networks (GAN) (Han et al., 2021), have been proposed for automatic medical report generation. However, these methods tend to produce factually incomplete and inconsistent reports (Tanida et al., 2023). To solve this problem, we developed a Mamba-based automatic report generation model, DX-Mamba. The Mamba model (Gu and Dao, 2023) was developed in 2023; it achieves fast inference and linear scaling in sequence length and excels at long sequence modeling. With the DX-Mamba model, we aim to improve the performance accuracy of deep learning models on the automatic report generation task.

## Approach

Figure 1  
Workflow of the DX-Mamba Model



We used the Dog-Xray dataset for this project, which was collected by Dr. Youshan Zhang's research group. The dataset includes 13,794 dog thoracic studies and 36,264 X-ray images, with most studies associated with three X-ray images from different views. Our automatic report generation model, DX-Mamba, as shown in Figure 1, applies the Mamba model as the backbone. Our DX-Mamba model consists of three novel modules: triple attention alignment (TAA), feature fusion state space model (FF-SSM), and features disentanglement state space model (FD-SSM). The TAA module is designed to align the text features with each image to ensure that text features are linked with X-rays from different object views. Aligned features are passed through the FF-SSM, which captures similar features across three X-ray images.

Fused features are then passed to the FD-SSM to distill distinct features across three images. Image features are then concatenated for the transformer-based language decoder for report prediction. We proposed a combined loss with inter-class loss, intra-class loss, and cross-entropy loss. The intra-class loss calculates distances between class samples and the center, while the inter-class loss calculates distances between different class centers. We evaluated the model's performance using four semantic metrics: BLEU, CIDEr, METEOR, and ROUGE, which measure the text and sentence structures similarity.

## Findings

We compared our DX-Mamba model with different methods using the Dog-Xray dataset, including Retrieval Augmented Generation (RAG) methods using different large language models, transformer-based models, and state-of-the-art report generation models. Experiment results showed that the DX-Mamba model outperforms all other methods across the four evaluation metrics.

We also conducted a semantic evaluation, where we compared a ground truth report with predicted reports from DX-Mamba and R2Gen-Mamba, which performs second to the DX-Mamba model. The DX-Mamba model produced a more similar report, contextually and in wording. The R2Gen-Mamba model, however, generated irrelevant information not emphasized in the original report, which may be inaccurate.

We also tested our model on a commonly used human lung report generation dataset, IU-Xray. Our model still outperformed previous methods across four metrics. The results indicated that our DX-Mamba model achieved state-of-the-art performance in automatic report generation in the veterinary and human medical fields.

## Conclusions and Recommendations

Extensive experiment results showed that our DX-Mamba achieves state-of-the-art performance on automatic report generation and determined its generalizability. We plan to modify our model to make it fully Mamba-based. This will further leverage the superior capacity of Vision Mamba on text and image feature learning and processing—and improve our model prediction accuracy.

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# LLM-Enhanced mmWave Data Synthesis for Environment-Adaptive Human Activity Recognition

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***Chengyi Liu***

M.S. in Artificial Intelligence

***Faculty Mentor***

Yucheng Xie, Ph.D.

## **Introduction**

Human Activity Recognition (HAR) enables a wide range of applications, including human-computer interaction, elderly fall detection, smart fitness coaching, and VR/AR body motion tracking. Vision-based HAR systems offer detailed spatial understanding but face privacy concerns and performance issues in poor lighting or occlusion [1,2], while sensor-based systems like wearables ensure better privacy but require direct contact with the user, which can be uncomfortable or impractical for long-term use [3,4]. Meanwhile, mmWave-based sensing for HAR has emerged as a promising alternative to traditional approaches, but the advancement and deployment of mmWave-based HAR are constrained by the high cost associated with collecting large-scale, labeled mmWave datasets from diverse environments [7,8]. To address the limitations, we develop LLM-enhanced mmWave data synthesis for environment-adaptive human activity recognition that includes four main components. First, large language models (LLMs) automatically generate structured activity descriptions with controllable motion attributes. Second, a motion synthesis model converts these descriptions into realistic and diverse motion sequences. Third, 3D human meshes are used to simulate personalized mmWave signal data via ray tracing. Finally, mmWave signals and textual descriptions are fused for robust activity recognition across different environments through LLM adaptation and inference.

Our work makes the following key contributions:

- We propose a mmWave activity data generation framework that integrates LLM-driven motion description generation with ray-tracing simulation informed by environmental effects and human body characteristics.
- We leverage LLM adaptation and inference to enable environment-adaptive mmWave-based HAR in diverse real-world scenarios.

## Method

In this section, we present a comprehensive overview of our proposed system, which is composed of four key components designed to support robust and environment-adaptive mmWave-based HAR using LLM. First, we develop the LLM-driven Activity Description Generation module, where a large language model automatically produces diverse, structured textual descriptions of human activities. These descriptions are enriched with controllable motion attributes such as speed and orientation, enabling detailed semantic guidance without the need for manual prompt engineering.

Building upon this foundation, the Realistic and Diverse Activity Sequence Synthesis component translates textual descriptions into motion sequences using a pretrained motion generation model. These sequences are then filtered to ensure biomechanical plausibility, semantic relevance, and diversity in motion styles. To bridge the gap between human motion and sensing modalities, the Personalized and Environment-aware mmWave Activity Data Simulation module constructs 3D human meshes using the Skinned Multi-Person Linear (SMPL) model [5], which are personalized based on shape and pose parameters. We then apply ray tracing [6] to model signal propagation affected by body shape and environmental structures. Finally, the LLM-empowered mmWave Activity Recognition module fuses mmWave signal data and textual environment descriptions, enabling cross-environment activity recognition through LLM adaptation and inference. This integrated pipeline allows the system to generalize across diverse scenarios and user contexts.

## Results

First, we evaluate the capability of our LLM-driven Activity Description Generation module by generating diverse, structured textual descriptions of common human activities. We define 28 common human activities as the target activity set. For each activity, a LLM (i.e., ChatGPT 4o) is used to generate 50 diverse textual descriptions. Each generated description incorporates speed and orientation attributes to capture motion variations in execution. Table 1 shows a set of descriptions generated for the activity “walk”.

**Table 1**

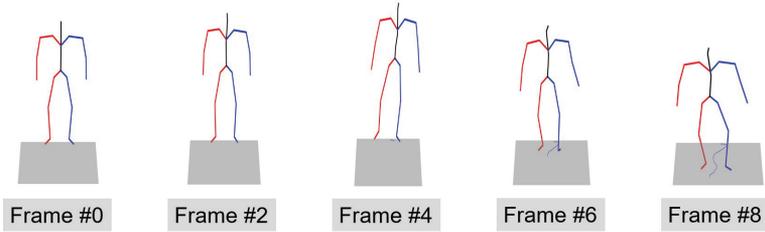
*A Set of Descriptions Generated for the Activity “Walk”*

1. A woman calmly walks down a straight path.
2. A man leisurely walking forward.
3. A girl bravely walks in a straight line.
4. A teenager reluctantly begins to walk.
5. A firefighter rapidly walking forward.
6. ....

Second, to evaluate the effectiveness of our Realistic and Diverse Activity Sequence Synthesis component, we synthesize realistic and diverse human activity sequences from textual descriptions. Figure 1 shows keyframes from a synthesized motion sequence of a woman calmly walking down a straight path. The skeleton maintains upright posture and exhibits smooth, symmetric leg and arm movement across frames, indicating biomechanically plausible and visually coherent motion. The motion was generated at 20 frames per second, and the selected frames (every 10 frames from Frame 0 to Frame 40) reflect steady progression.

**Figure 1**

*Keyframes from a synthesized motion sequence of a woman calmly walking down a straight path.*



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# Confident Pseudo-labeled Diffusion Augmentation for Canine Cardiomegaly Detection

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## ***Shiman Zhang***

M.S. in Artificial Intelligence

## ***Faculty Mentor***

Youshan Zhang, Ph.D.

## **Introduction**

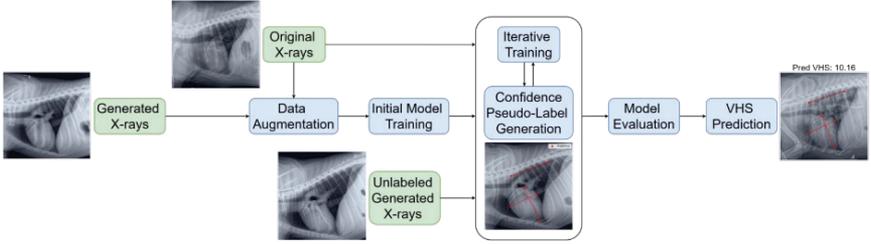
Canine cardiomegaly presents serious health risks, and traditional vertebral heart score (VHS) methods are limited by subjectivity and inconsistency, emphasizing the need for automated and accurate diagnostic approaches. Recent advances in deep learning (DL) and convolutional neural networks (CNNs) have shown promise in medical imaging (Li & Zhang, 2024), but existing veterinary applications often rely on small, poorly annotated datasets, leading to poor generalization. To address data scarcity, we propose the Confident Pseudo-labeled Diffusion Augmentation (CDA) model, which uses Latent Diffusion Models (Rombach et al., 2022) to generate 3,000 synthetic canine chest X-rays annotated with VHS key points, significantly expanding and diversifying the training data. By integrating pseudo-labeling (Lee, 2013) and uncertainty estimation via Monte Carlo Dropout (Gal & Ghahramani, 2016), CDA selectively incorporates high-confidence labels to iteratively refine the training set, improving accuracy and robustness over traditional approaches.

## **Method**

We propose the Confident Pseudo-labeled Diffusion Augmentation (CDA) model, an AI-based method for automated Vertebral Heart Score (VHS) prediction from canine chest X-rays, as illustrated in Figure 1. CDA combines synthetic data generation via diffusion models, pseudo-labeling with Monte

Carlo Dropout to exploit unlabeled data, and a task-optimized neural network architecture. The complete training algorithms is detailed in Figure 2.

**Figure 1**  
Overall Framework of the Confident Pseudo-labeled Diffusion Augmentation (CDA) Model



**Figure 2**  
Training Algorithms and Formulations of the CDA Model

**Algorithm 1** Training Initial CDA Model

**Require:** Canine X-ray images  $X = \{x_i\}_{i=1}^n$  and corresponding VHS-labeled key points  $P = \{y_i\}_{i=1}^n$ , where  $n$  is the total number of images.

**Ensure:** Predicted VHS scores and classifications for heart size.

- 1: **for** epoch = 1 to num\_epochs **do**
- 2: **for** each mini-batch  $B(X)$  and  $B(P)$  sampled from  $X$  and  $P$  **do**
- 3: Compute true VHS scores and classification labels using Eq. (1).
- 4: Apply model  $f$  to predict VHS scores and heart size classes.
- 5: Calculate total loss  $\mathcal{L}$  using Eq. (2).
- 6: Update model parameters via backpropagation and optimizer step.
- 7: **end for**
- 8: **end for**
- 9: **return** Final trained model for VHS prediction and cardiomegaly classification.

**Algorithm 2** Pseudo-Labeling with Monte Carlo Dropout

**Require:** Pre-trained model  $f$ , labeled dataset  $\mathcal{D}_{\text{labeled}}$ , unlabeled dataset  $\mathcal{D}_{\text{unlabeled}}$ , confidence threshold  $\tau$ , number of MC Dropout passes  $K$ .

**Ensure:** Trained model with improved performance.

- 1: **for** epoch = 1 to num\_epochs **do**
- 2: Train  $f$  on  $\mathcal{D}_{\text{labeled}}$  using the current loss function.
- 3: Enable MC Dropout during inference for  $\mathcal{D}_{\text{unlabeled}}$ .
- 4: **for** each image  $x \in \mathcal{D}_{\text{unlabeled}}$  **do**
- 5: Perform  $K$  stochastic forward passes to obtain  $\{f_k(x)\}_{k=1}^K$ .
- 6: Compute mean prediction  $\mu(x)$  and uncertainty  $\sigma(x)$  using Eqs. (3) and (4).
- 7: **end for**
- 8: Select high-confidence samples  $\mathcal{C}$  based on  $\max(\sigma(x)) < \tau$ .
- 9: Combine  $\mathcal{C}$  with  $\mathcal{D}_{\text{labeled}}$  to create an expanded training dataset.
- 10: **end for**
- 11: **return** Trained model  $f$ .

$$y_i = \begin{cases} 0 & \text{if VHS} < 8.2, \\ 1 & \text{if } 8.2 \leq \text{VHS} \leq 10, \\ 2 & \text{if VHS} > 10. \end{cases} \quad (1)$$

$$\mathcal{L} = \frac{1}{n} \sum_{i=1}^n \left( 10 \cdot \mathcal{L}_{L1}(f(x_i), y_i^{\text{label}}) + 0.1 \cdot \mathcal{L}_{L1}(\text{calc.vhs}(f(x_i)), y_i^{\text{VHS}}) + \mathbb{I}_{\{\text{epoch} > 10\}} \cdot \mathcal{L}_{L1}(f(x_i), y_i^{\text{old}}) \right), \quad (2)$$

where  $\mathcal{L}_{L1}$  represents the mean absolute error (L1 loss).

$$\mu(x) = \frac{1}{K} \sum_{k=1}^K f_k(x), \quad (3)$$

$$\sigma(x) = \sqrt{\frac{1}{K} \sum_{k=1}^K (f_k(x) - \mu(x))^2}, \quad (4)$$

where  $\mu(x)$  represents the pseudo-label, and  $\sigma(x)$  represents the model's uncertainty.

## Results

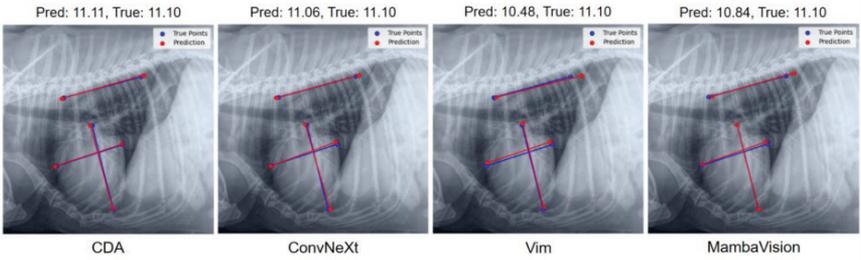
Table 1 compares the performance of state-of-the-art models, showing that our CDA model achieves the highest test accuracy of 92.8%, surpassing ConvNeXt (89.8%), MambaVision (86.8%), and ViM (71.5%). Without pseudo-labeling, CDA reaches 91.0%, highlighting the significant performance gain from leveraging high-confidence pseudo-labeled samples. Figure 3 presents a visual comparison of predicted key points and VHS values across different models. The CDA model shows superior alignment between the predicted key points (red) and the true anatomical key points (blue), resulting in a predicted VHS value that most closely matches the ground truth.

**Table 1**  
*Quantitative Performance Comparison of Different Methods*

Model	Valid ACC	Test ACC
ConvNeXt (Liu et al., 2022)	89.5	89.8
Vim (Zhu et al., 2024)	73.5	71.5
MambaVision (Hatamizadeh & Kautz, 2024)	87.5	86.8
<b>CDA w/o CPL</b>	<b>88.5</b>	<b>91.0</b>
<b>CDA</b>	<b>89.5</b>	<b>92.8</b>

*Note.* Acc: accuracy, CPL: Confident Pseudo Labels.

**Figure 3**  
*Qualitative Visualization of VHS Predictions*



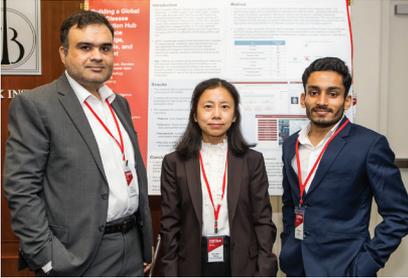
## Conclusions and Recommendations

We propose a novel deep learning method for automated Vertebral Heart Score (VHS) prediction and canine cardiomegaly classification, combining pseudo-labeling with Monte Carlo Dropout and synthetic data augmentation to address the scarcity of labeled veterinary imaging data. The model achieved 92.8% test accuracy, outperforming state-of-the-art approaches and showing promise for improving early diagnosis and clinical outcomes in canine cardiology. However, performance is affected by the quality of synthetic data, fixed pseudo-labeling thresholds may exclude valuable samples, and high computational costs could hinder use in low-resource settings. Future work will focus on adaptive pseudo-labeling, improved data generation, cross-modality learning, and external validation to enhance robustness and clinical applicability.

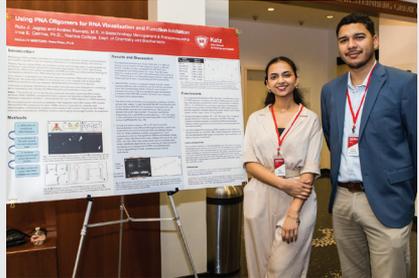
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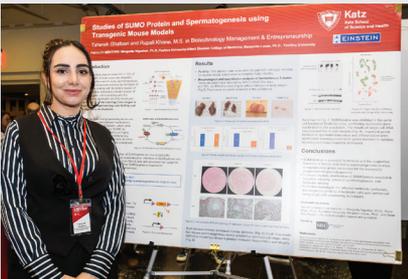
# Biotechnology Management and Entrepreneurship



*Naveen Khetarpal, Dandan Wang and Prashant Soni*



*Rutu J. Jagtap and Andres Romero*



*Tahereh Ghafoori*



*Jenny Maharjan*

# Building a Global Rare Disease Information Hub to Advance Knowledge, Diagnosis and Treatment

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***Naveen Khetarpal, Dandan Wang and Ebenezer Ajao***

M.S. in Biotechnology Management and Entrepreneurship

***Prashant Soni***

M.S. in Artificial Intelligence

## ***Faculty Mentors***

Youshan Zhang, Ph.D., and Rana Khan, Ph.D.

## **Introduction**

Rare diseases (RD) are defined as conditions affecting fewer than 1 in 2000 people in any WHO region (Lancet, 2024). Despite their rarity, there are over 7000 known RD, collectively impacting approximately 300 million people globally and ~30 million in the U.S (FDA, 2024). Around 80% of RD have a genetic cause, 70% of which manifest in childhood. Current data suggests that a staggering 95% of RD lack approved treatments and the average time to accurate diagnosis is 4.8 years, with 30% of affected children dying before age five (Lancet, 2024). Although a substantial body of research and information on rare diseases (RD) exists, it is often region-specific, fragmented, and unstructured, making it time-consuming and difficult for clinicians to retrieve the data necessary for accurate diagnosis and effective treatment. There is a critical need for a centralized, accessible repository to streamline access to this essential information. This project aims to address this gap by developing an interactive and structured repository of clinical innovations related to rare diseases. By consolidating RD-related data, the repository will support earlier diagnosis and more informed treat-

ment recommendations-two of the most persistent challenges in the field (IQVIA, 2023).

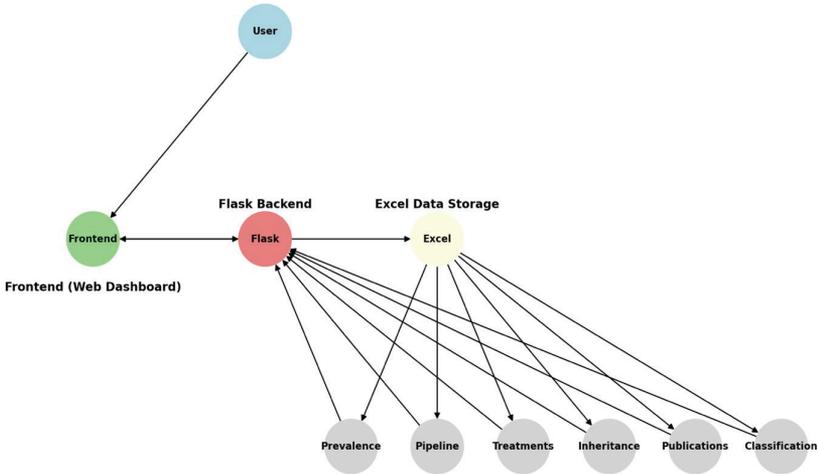
## Method

This project focuses on approximately 4,000 of the most prevalent rare diseases (RDs). The methodology began with a comprehensive literature and internet search, gathering information on RD types, prevalence, geographic distribution, patient demographics, available treatments, therapies in development, and the companies involved in their development. This was followed by an in-depth scientific analysis of relevant databases, with Orphanet selected as a model due to the high quality and computability of its datasets available through the Orphadata platform. In addition, other reputable scholarly resources were leveraged, including the FDA’s Orphan Drug Database, the FDA’s Orange Book and PubMed. These sources contributed to the creation of a global RD information hub encompassing scientific classifications, symptoms, genetic variations, publications, available and emerging treatments.

**Figure 1**  
*Study Workflow*

Disease	Estimated prevalence (/100,000)
Down syndrome	95.0 BP
Cleft lip/palate	80.0 BP
Fetal and neonatal alloimmune thrombocytopenia	39.6307
Renal agenesis, unilateral	50.0 BP
Pneumonia caused by Pseudomonas aeruginosa infection	50.0 *
47,XY syndrome	50.0 BP*
Iniencephaly	50.0 BP*
Congenital bilateral absence of vas deferens	50.0 *
Primary Sjögren syndrome	48.99 *
B-cell chronic lymphocytic leukemia	48.0

**Figure 2**  
*Rare Disease Dashboard-System Architecture*



## Results

The collected data has been systematically organized into an Excel spreadsheet, which serves as the foundational dataset for the project. This dataset was integrated into a user-friendly web-based application, resulting in the successful creation of an interactive dashboard accessible online. The database is designed to offer comprehensive insights and support for a range of stakeholders:

- **Patients:** Facilitates early diagnosis and identification of appropriate treatment options.
- **Clinicians:** Provides streamlined access to validated, detailed data to support evidence-based clinical decision-making.
- **Researchers:** Enhances the pace of discovery by offering a centralized, structured repository of relevant information.
- **Startups and Pharmaceutical Companies:** Delivers insights into the competitive landscape and informs strategic development opportunities.

Figure 3  
OrphanAtlas: Landing Page

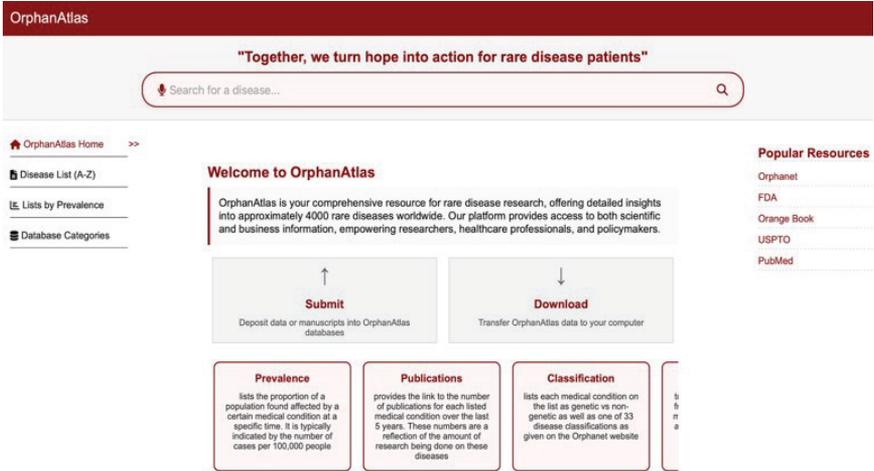
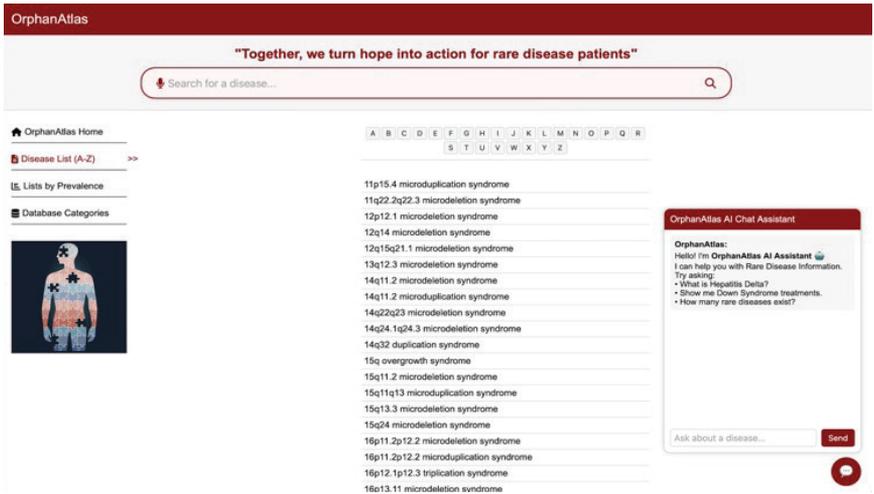
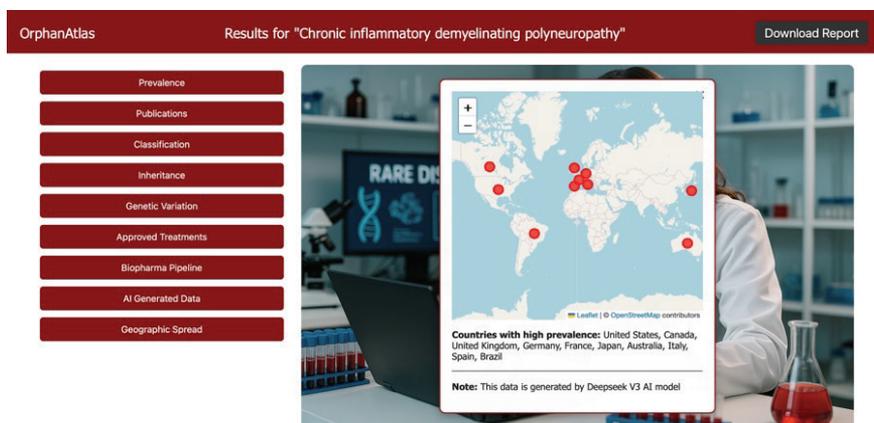


Figure 4  
OrphanAtlas: List by Prevalence & AI Chat Assistant



**Figure 5**

*OrphanAtlas: Disease Insights & Geographical Distribution*



## Conclusions and Recommendations

A distinctive feature of this project is its integration of key information from across the rare disease (RD) landscape-encompassing both scientific and commercial domains. By consolidating data on biopharmaceutical pipelines, patents, and scientific publications, the project offers a comprehensive and transparent view of ongoing research and innovation in this critical field. The repository empowers stakeholders to have faster access to critical data, supporting early diagnosis and treatment planning. This initiative has the potential to transform care, improve patient outcomes, and accelerate advancements in research and treatment of RD. Future work include implementing a user authentication system for the personalized experiences and integrating AI/ML for predicting disease patterns and treatment suggestions. Also, expanding the database with more rare disease datasets and developing an API for third-party integrations.

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

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IQVIA. (2023). Recent advancements in the rare disease landscape. Accessed January 28, 2025. <https://www.iqvia.com/locations/united-kingdom/blogs/2023/02/recent-advancements-in-the-rare-disease-landscape>

# Using PNA Oligomers for RNA Visualization and Function Inhibition

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***Rutu J. Jagtap and Andres Romero***

M.S. in Biotechnology Management and Entrepreneurship

***Irina E. Catrina, Ph.D.***

Yeshiva College

***Faculty Mentor***

Rana Khan, Ph.D.

## **Introduction**

Messenger RNA (mRNA) translation is a fundamental cellular process essential for proper gene expression and protein synthesis. The ability to regulate this process with spatial and temporal precision holds profound implications for both molecular biology research and the development of targeted medical therapies. In recent years, Peptide Nucleic Acids (PNAs) have emerged as promising tools in molecular research due to their structural and biochemical properties. PNAs are synthetic analogs of nucleic acids in which the traditional sugar-phosphate backbone is replaced with a peptide-like structure. This structural modification confers resistance to enzymatic degradation and enables PNAs to bind complementary RNA or DNA sequences with high specificity and affinity. The ability of PNAs to form stable complexes with nucleic acids opens the door to new approaches for modulating gene expression, such as inhibiting translation, and detecting RNA molecules in both fixed and live specimens. Despite their potential, a comprehensive understanding of PNA–nucleic acid interaction dynamics remains incomplete. Particularly, the use of PNAs in live-cell imaging and

their potential in tracking RNA transport during key developmental processes is underexplored and poorly understood.

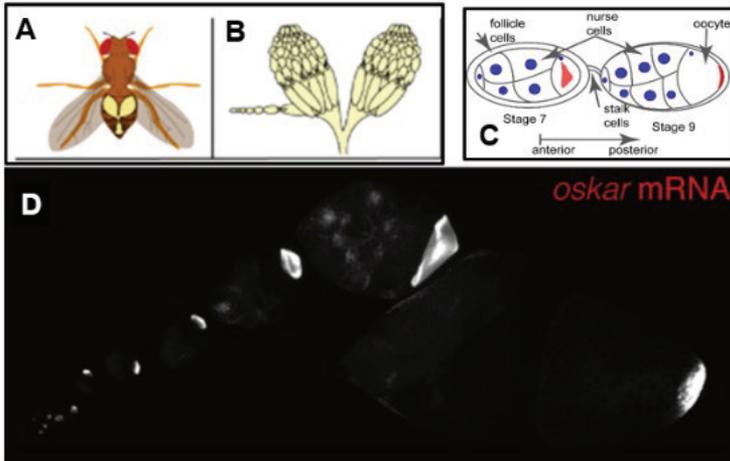
This study aimed to address the existing knowledge gaps by investigating the molecular principles underlying formation of Peptide Nucleic Acid (PNA)–double-stranded DNA (dsDNA) complexes. The findings are intended to inform future evaluations of PNA-mediated translational inhibition and to assess the potential of using PNA oligomers for RNA detection. The research utilized DNA hairpin (HP) models derived from the *oskar* mRNA sequence (Fig. 1C & D), a gene essential for posterior axis specifications in *Drosophila melanogaster* embryos (Fig. 1A & B).

## **Method**

To investigate the formation of PNA–DNA complexes, candidate DNA hairpin structures derived from the *oskar* mRNA sequence were synthesized and analyzed using native polyacrylamide gel electrophoresis (PAGE) (Fig. 2A). This technique was employed to evaluate the molecular principles governing the formation of triple helix structures between PNA oligomers and the stem regions of DNA hairpins (Fig. 2C). The stability of these PNA–DNA interactions was assessed by varying the PNA concentration. Under conditions of high PNA concentration and extended incubation, evidence of strand invasion by PNA into the hairpin stem was observed. This indicated strong binding affinity and potential disruption of native DNA structures. Electrophoretic band patterns were analyzed and quantified to assess the efficiency of PNA binding to different hairpin sequences. These results provided insights into the strength and stability of PNA–nucleic acid complexes, informing the potential of using PNAs for applications in gene regulation and RNA detection and visualization.

**Figure 1**

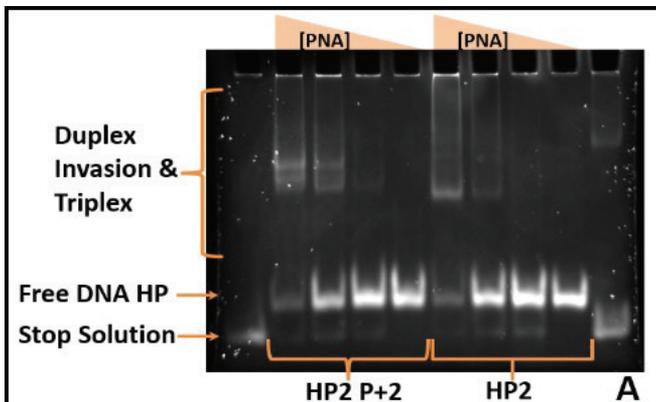
*The Fruit Fly Egg Chamber as Model Organism*



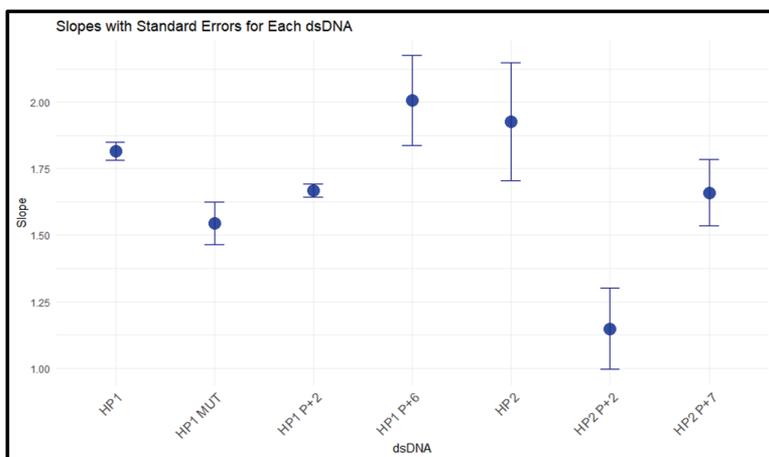
*Note.* The female fruit fly (A), contains a pair of ovaries (B), composed of ovarioles, which are made of egg chambers at various stages of development (C, D), with *oskar* mRNA presenting a posterior localization beginning in stage 9 (C, D) (1,2).

**Figure 2**

*Examples of Native PAGE Results DNA Hairpins Models*





**Figure 3***Slope Values for Various DNA Hairpin Models*

*Note.* Slope ( $\gamma$ ) values for the indicated DNA HPs calculated using a custom R script. Sequence variations for HP1 and HP2 are indicated as “P+n”, with n as the number of nucleotides that can form a duplex with the loop of each HP immediately adjacent to the predicted Hoogsteen base pairs

**Table 1***Results from Kinetic Studies*

<b>dsDNA (REPLICATED)</b>	<b>SLOPE WITH STD ERROR</b>
HP1	1.816 ± 0.035
HP1MUT	1,544 ± 0.08
HP1 P+2	1,668 ± 0.024
HP1 P+6	2.007 ± 0.168
HP2	1.926 ± 0.223
HP2 P+2	1.148 ± 0.153
HP2 P+7	1.66 ± 0.126

*Note.* Graphical representation of slope ( $\gamma$ ) for the indicated HPs.

## Conclusions and Recommendations

This study demonstrated that extended PNA oligomers can efficiently invade A:T-rich DNA hairpins under near-physiological salt conditions and reduced PNA excess, expanding the known parameters for effective DNA duplex invasion (Fig. 2B). The interaction followed pseudo-first-order kinetics, with comparable efficiency to previously reported long dsDNA systems. Among the seven tested hairpins, HP1, HP1 MUT, and HP2 showed better complex formation efficiency. Although statistical differences among the hairpins were not significant, ongoing optimization aims to improve reproducibility and data resolution. These findings support the potential of rationally designed PNAs to target structured DNA and RNA regions offering promising applications in molecular detection, imaging, and gene function modulation.

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# Studies of SUMO Protein and Spermatogenesis Using Transgenic Mouse Models

**Tahereh Ghafoori and Rupali Khane**

M.S. in Biotechnology Management and Entrepreneurship

## **Faculty Mentors**

Margarita Vigodner, Ph.D., and Benjamin Lucas, Ph.D.

## **Introduction**

Infertility affects up to 12% of couples, with approximately half of male cases remaining unexplained.<sup>1</sup> This underscores the critical need to better understand spermatogenesis—a highly regulated process involving mitosis, meiosis, and sperm maturation. SUMOylation, a key post-translational modification, plays an important yet underexplored role in regulating this process (2, 3).

**Figure 1**  
*Spermatogenesis Process*

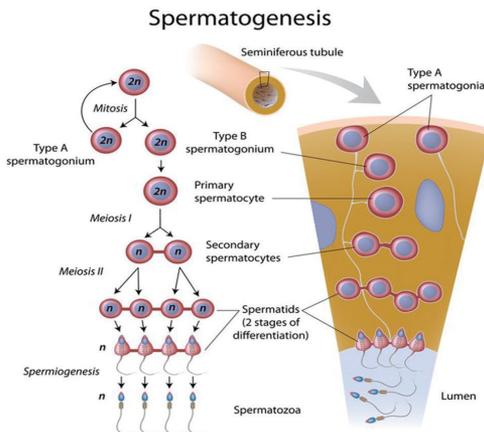
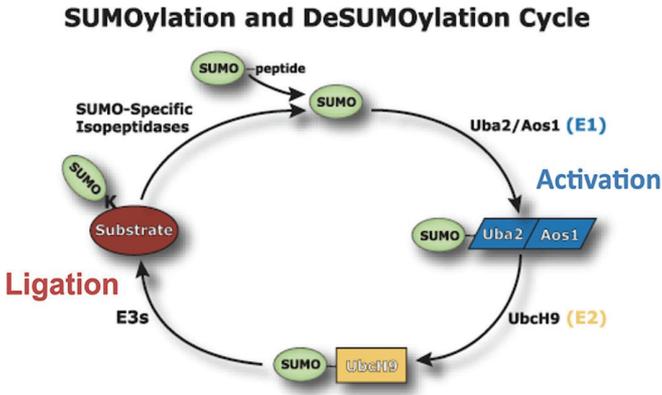


Figure 2

*SUMOylation and DeSUMOylation cycle*



SUMOylation is a post-translational modification that attaches small ubiquitin-like modifiers (SUMO) to target proteins, affecting their stability, localization, and interaction with other proteins (Fig. 2). SUMO proteins are abundantly expressed in testicular cells and are involved in regulating spermatogenesis. Prior ex-vivo studies in mouse spermatocytes illustrate that inhibiting SUMOylation caused meiotic arrest and induced apoptosis in Sertoli cells (4). However, whether SUMOylation is essential in vivo for spermatogenesis has not been established (5).

## Methods

To investigate the in vivo role of SUMOylation in male fertility, the researchers genetically inactivated UBA2, a key enzyme that initiates SUMOylation, using the Cre-LoxP system. Two transgenic mouse models were used: Stra8-Cre, targeting germ cells, and AMH-Cre, targeting Sertoli cells. Successful inactivation of UBA2 was confirmed in the target populations (Fig.5). Single-cell RNA sequencing (scRNA-seq) was then performed to assess transcriptional changes in testicular cells.

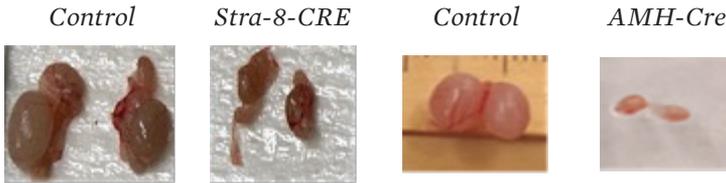
## Results

**Fertility Assessment:** When co-housed with wild-type females, both mutant mouse models displayed complete male infertility.

**Morphological and Histological Changes in Testes:** Testicular weights were reduced by ~50% in Stra8-Cre and ~75% in AMH-Cre mice, despite normal body weights (Fig.3). No sperms were found in the epididymis, and seminiferous tubules showed reduced diameter (Fig. 5). Histology revealed spermatogenesis arrest at the spermatocyte stage in Stra8-Cre mice, while AMH-Cre mice showed severe testicular degeneration and atrophy.

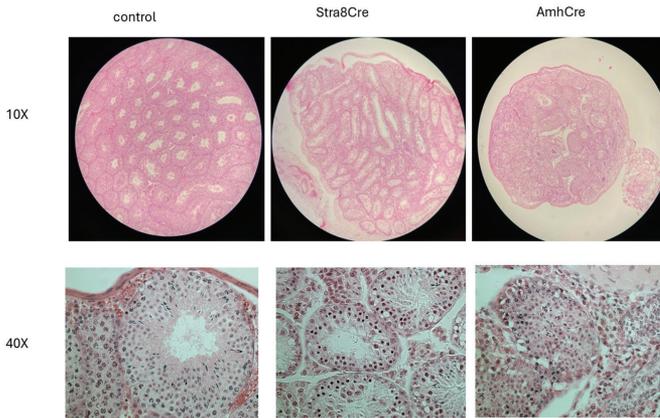
**Figure 3**

*Testes size of Control and Experiment Mice*



**Figure 4**

*Hematoxylin & Eosin Staining of Testicular tissue of Control and Experimental Mice*



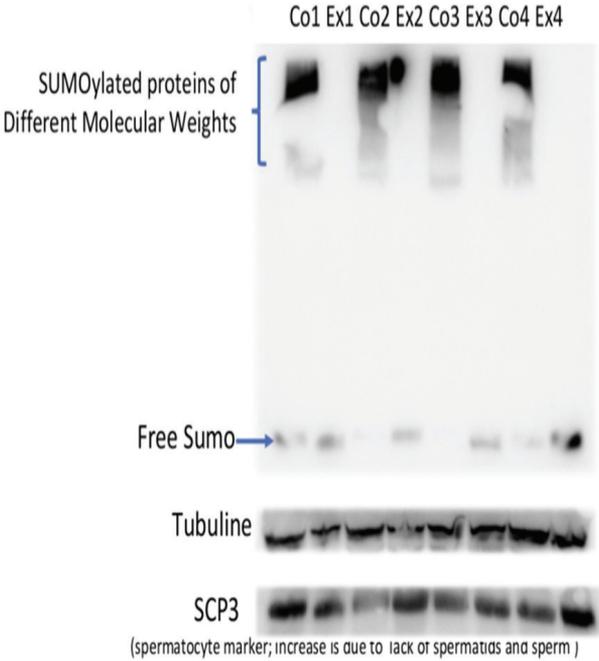
**Inactivation of SUMOylation:** As shown in Fig.5 on Western Blot analysis SUMOylation was successfully inhibited in germ cells of Stra8-Cre mice, as confirmed by the absence of SUMOylated proteins.

**Gene Expression Changes:** scRNA-seq revealed significant downregulation of genes associated with spermatid maturation and differentiation in both mouse models. Conversely, genes linked to cytokine signaling and stress responses were upregulated (Fig.6).

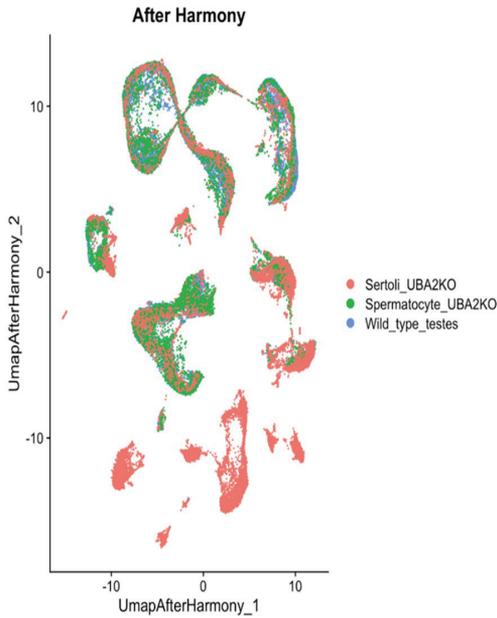
This study was supported by a Katz School of Science and Health Faculty Research Initiative grant.

**Figure 5**

*Western Blot Analysis*



**Figure 6**  
*sc RNAseq Experiment Umap*



## Conclusion

Our findings underscore the essential role of SUMOylation in spermatogenesis and the maintenance of Sertoli cell function. In vivo inactivation of SUMOylation disrupts key transcriptional programs, impairs sperm development, and leads to irreversible infertility in male mice. These results highlight the regulatory significance of SUMOylation in germ cell development and suggest its potential relevance to human male infertility. Ongoing studies, including pathway analysis of scRNA-seq data, aim to identify specific molecular targets impacted by SUMO pathway disruption.

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# Development of Radioimmunoconjugate for the Diagnosis and Treatment of Osteosarcoma with a Focus in Pediatric Population

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## ***Jenny Maharjan***

M.S. in Biotechnology Management and Entrepreneurship

## ***Faculty Mentor***

Robert Friedman, MBA

## ***Industry Mentor***

Natasha Shtraizent, Ph.D., Frezent Biological Solutions

## **Introduction**

Cancer remains a leading cause of death globally, with current therapies often limited by off-target effects and poor tumor specificity (Bodei et al., 2022). Osteosarcoma is the most common form of bone cancer, particularly affecting children, teenagers, and young adults and has a high rate of recurrence, particularly among patients who initially present with localized disease and later develop metastases (John Hopkins Medicine, 2024).

**Radiotheranostics**, the combination of diagnostic imaging and targeted radiotherapy, offers great promise for improving cancer treatment. Among radiotheranostic modalities, **radioimmunoconjugates**, which consist of antibodies labeled with radionuclides, enable precise targeting of tumor-associated antigens, thereby minimizing damage to healthy tissues (Duan et al., 2021). However, several challenges remain, including the optimization of radiolabeling techniques, enhancement of tumor uptake, and the establishment of well-defined Target Product Profiles (TPPs) to guide clin-

ical application (Cheal et al., 2022).

This project explores the development and strategic analysis of a radioimmunoconjugate therapy under development by Frezent Biological Solutions, an emerging biotechnology startup. The objectives include:

1. Evaluating the current landscape of radiopharmaceuticals and theranostics,
2. Defining a clinically relevant TPP for Frezent's candidate, and
3. Identifying a viable beachhead market and commercial opportunity.

By integrating regulatory and market insights with a competitive landscape analysis, this report underscores the transformative potential of Frezent's innovation and provides a strategic foundation for investment and collaboration in the evolving field of targeted oncology.

## Approach

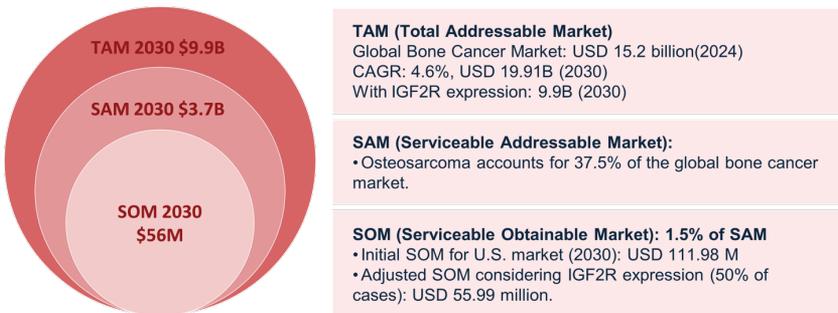
To achieve the project's objectives, a structured approach was employed across three key areas. **First**, a comprehensive market landscape analysis was conducted to evaluate key players, emerging technologies, and innovation trends in the radiopharmaceutical and theranostics space, with a particular focus on radioimmunoconjugates. **Second**, a Target Product Profile (TPP) was defined for a radiotheranostic targeting osteosarcoma, outlining optimal characteristics such as age-specific dosing and safety profiles (Duan et al., 2021). **Lastly**, a commercial opportunity assessment was carried out to propose a beachhead market, focusing on IGF2R expression in osteosarcoma and evaluating the therapy's market potential. These strategies were designed to provide current and prospective investors with the knowledge needed to assess the strategic viability, risks, and benefits of potential collaboration with Frezent.

## Findings

The field of radiotheranostics is advancing at a remarkable pace, driven by key players like Novartis, Telix Pharma, RadioPharm Therapeutics, Y-mAbs, and Defence Therapeutics. The use of radionuclides, including Lutetium-177, and emerging technologies such as SADA PRIT and Accum<sup>®</sup>, is driving progress in targeted radioimmunoconjugates. In developing a Target Product Profile (TPP) for a novel osteosarcoma radiotheranostic, IGF2R was

identified as a key molecular target, with Technetium-99m and Actinium-225 selected for their diagnostic and therapeutic potential respectively (Duan et al., 2021). The analysis also reveals that the U.S. osteosarcoma treatment market represents a significant Serviceable Obtainable Market (SOM), with potential for a niche opportunity targeting IGF2R expression. These findings underscore the strong market potential and therapeutic promise of Frezent’s novel radioimmunoconjugate therapy, offering prospects for improved survival outcomes and personalized treatment options for osteosarcoma patients.

**Figure 1**  
*Market for Frezent*



**Conclusion and Recommendations**

This project identified key strategic opportunities to support the development of Frezent’s novel radioimmunoconjugate therapy for osteosarcoma. Through an in-depth analysis of approved therapies, ongoing clinical trials, and competitive landscape, the study positioned Frezent’s candidate to address critical gaps in current treatment. IGF2R was validated as a promising molecular target, and appropriate diagnostic and therapeutic radioisotopes were selected to enhance efficacy and specificity. Additionally, a well-defined Target Product Profile (TPP) was established to align with regulatory and clinical expectations.

With a projected serviceable obtainable market (SOM) of \$56 million by 2030, Frezent is strategically advancing a differentiated radiotheranostic therapy with the potential to significantly improve patient outcomes and redefine osteosarcoma treatment.

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## Cybersecurity



*Laticbe Elijah, Joy Awoleye and  
Christine Macharia*

# A Unified Online Platform for University Student Associations and Alumni

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***Joy Awoleye, Laticbe Elijah and Christine Macharia***

M.S. in Cybersecurity

## ***Faculty Mentor***

Elad Hod, M.S., CISSP

## **Introduction**

Students and alumni often struggle to find people from their backgrounds whose interests and professional goals align with theirs. These individuals may juggle fragmented communication channels and separate platforms to stay in touch with their communities, associations, and faculty (Anand, 2025). Current platforms operate in silos. Information is often dispersed across multiple channels (Omondi, 2024, p. 1). This project aims to develop an inclusive, secure, and user-friendly, one-stop platform that engages students and alumni from multiple universities across the New York Metropolitan area.

## **Approach**

The application follows the MVC (Model-View-Controller) architecture to separate development concerns, enhance maintainability, and facilitate the project's scaling (TutorialsPoint, n.d.). The app's front end was developed using HTML5, CSS3, JavaScript (ES6+), jQuery, and the Bootstrap framework. The backend was developed using Laravel. This PHP framework processes business logic, handles interactions between the front end and the database, and implements a RESTful API and communication with the front end. The MySQL database stores application data, including user profiles and logs. To secure the application, we followed the Open Web Appli-

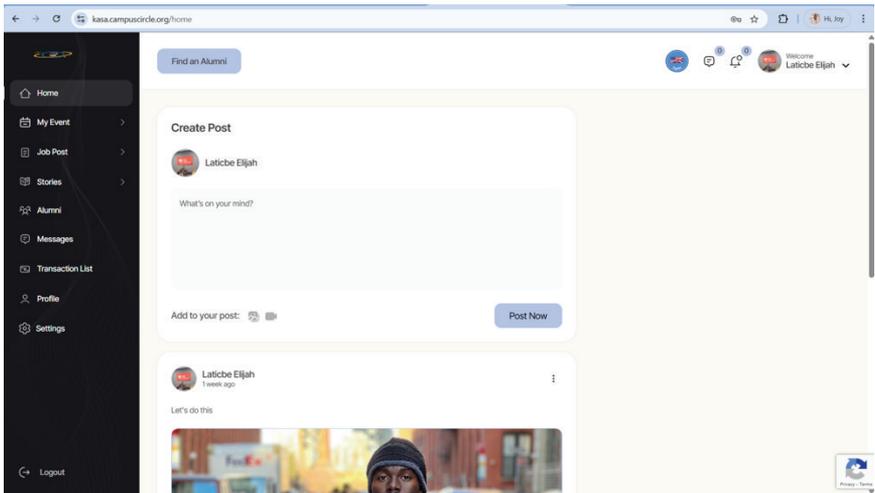
cation Security Project (OWASP) listed secure coding standards (OWASP Foundation, n.d.), guidelines established by the General Data Protection Regulations (GDPR), and conducted vulnerability assessment and penetration testing.

## Outcomes

We successfully hosted the application on <https://campuscircle.org/> and conducted unit, functional, usability, and system tests to ensure the platform met the specified requirements. Katz African Student Association (KASA) leadership at Yeshiva University used the voting feature to conduct its 2025/2026 cabinet election, resolving complaints about an earlier election that used the less-secure Google Forms application.

**Figure 1**

*Screenshot of the user dashboard with a menu for different actions, such as an in-app messaging feature*



## Conclusions and Recommendations

To enhance the application, features that deliver AI-driven suggestions tailored to individual interests have been proposed. These include **AI-Powered Matchmaking**, **Geolocation-Based Meetups**, and **Personalized Content Feeds**. This community-based platform will enhance collaboration

and foster meaningful engagement among students and alumni. The platform will be based on shared academic backgrounds, career aspirations, extracurricular interests, and geographic proximity, building strong purpose-driven communities that thrive on mutual support and shared aspirations.

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# Data Analytics and Visualization



*Chengkun Yao, Dr. David Li and  
Cheng Li*

# A Dynamic Framework for Optimizing Reward Policies in the Sharing Economy

---

## ***Cheng Li***

M.S. in Data Analytics and Visualization

## ***Chengkun Yao***

M.S. in Digital Marketing and Media

## ***Angela Li***

Applied Mathematics and Physics, Stony Brook University

## ***Faculty Mentor***

David Li, Ph.D.

## **Introduction**

The sharing economy has transformed resource utilization through platforms such as Uber and Airbnb, which demonstrate significant impacts on traditional industries (Zervas et al., 2017). This model emphasizes sustainability and income generation (Sundararajan, 2016). Prior research highlights static reward mechanisms as insufficient for adaption to dynamic user behaviors and market conditions (Mi & Coffman, 2019). Game theory offers insights into resource optimization. Existing models, however, often lack integration with behavioral economics, a field which investigates how non-monetary factors (e.g. social recognition) influence participation (Gneezy et al., 2011) and scalability (Chang et al., 2021). This study addresses these gaps by proposing a dynamic framework that optimizes reward policies using Nash equilibrium and dynamic programming. Key questions

include: How can reward policies adapt to real-time data while ensuring fairness? Can dynamic incentives balance platform profitability and minimum service thresholds? The aim is to develop a scalable framework that maximizes user engagement and resource efficiency within budget constraints, focusing on variables such as incentive costs, shopper participation probabilities, and one-time purchase (OTP) fulfillment rates.

## Method

The study employed a dynamic Nash equilibrium model, assuming shoppers adapt strategies based on real-time incentives. A dynamic programming algorithm recursively selected shoppers to maximize OTP within budget limits. Key variables included  $c_i$  (incentive for the  $i^{\text{th}}$  shopper),  $p_i$  (probability of participation), and  $O(n)$  (OTP as a function of shoppers). The algorithm prioritized shoppers offering the highest marginal profit, calculated as  $\alpha \cdot \delta O_j - c_j \cdot p_j$ , where  $\alpha$  represents the dollar value of OTP. Constraints included a minimum OTP threshold ( $O_L=81\%$ ) and budget upper bound ( $B_H$ ). Simulated data tested scenarios with varying shopper numbers, budgets, and market conditions.

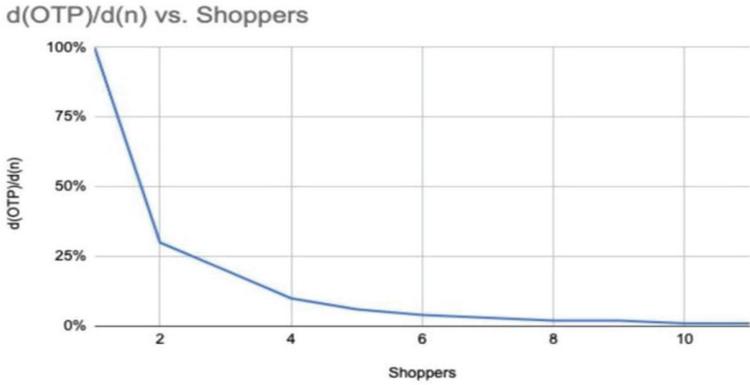
## Results

Scenario-based analyses revealed OTP fulfillment rates increased monotonically with shopper participation, reaching diminishing returns at higher levels (Fig. 1). The algorithm allocated incentives to high-impact users, maintaining  $O(n) \geq O_L$  while minimizing costs. Under tight budgets, OTP rates remained stable due to strategic reallocation (Fig. 2).

# Scenario-Based Analyses: One-Time Purchase (OTP) Fulfillment Rates

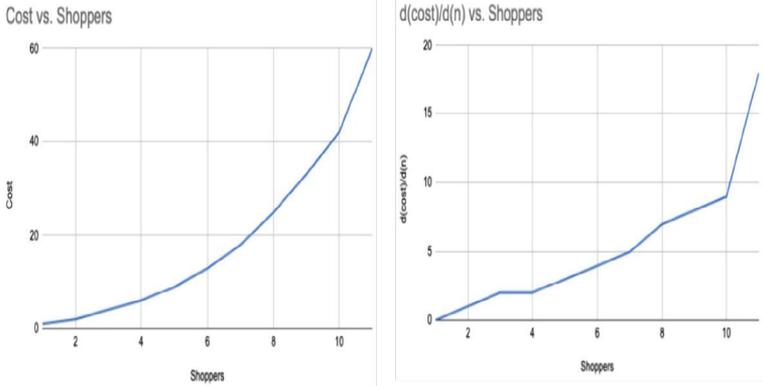
**Figure 1**

*Diminishing returns at higher levels*

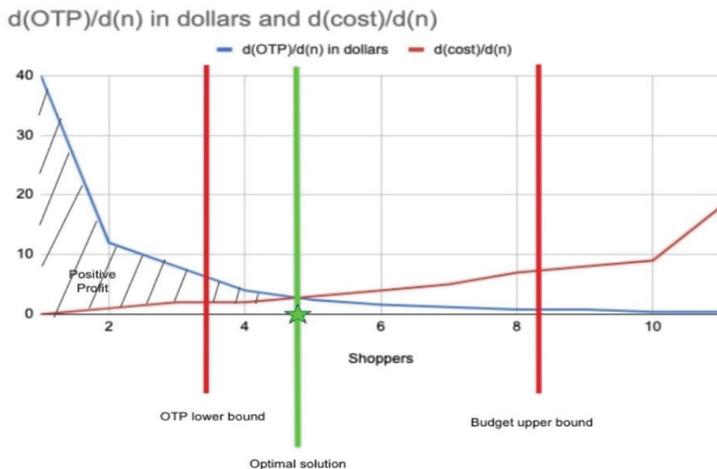


**Figure 2**

*Allocating incentives to high-impact users*



**Figure 3**  
*Optimal stopping points incentivizing consumers*



Marginal cost-profit analysis identified optimal stopping points for incentivizing consumers, ensuring rewards generated positive returns (Fig. 3). Calibrating  $\alpha$  through risk-neutral pricing ensured budget adherence, with solutions invariant to minor  $\alpha$  adjustments.

### Conclusions and Recommendations

The framework successfully balances efficiency, profitability, and fairness in reward allocation. Limitations include reliance on simulated data and assumptions of shopper independence. Future research should integrate machine learning for real-time predictions and test scalability across diverse platforms such as ride-sharing or freelance markets. Long-term studies on user retention and sustainability are recommended to refine adaptive policies.

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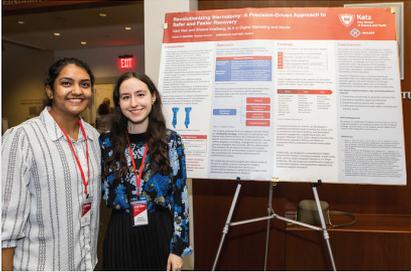
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# Digital Marketing and Media



*Vani Nair and Sheera Kraitberg*



*Sagarika Shrestha (center)*



*Mansi Kamboj (left)*

# Revolutionizing Sternotomy: A Precision-Driven Approach to Safer and Faster Recovery

---

***Sheera Kraitberg and Vani Nair***

M.S. in Digital Marketing and Media

***Faculty Mentor***

Thomas Kennon

## **Introduction**

Sternotomy, a critical procedure for cardiac and thoracic surgeries, has remained largely unchanged for decades, relying on straight-line cuts and metal wire reattachment. These traditional methods often result in extended recovery times, infection risk, and patient discomfort (Song et al., 2023; Park et al., 2010). While other surgical areas have seen significant innovation, sternotomy techniques have lagged. Healers, a startup company, has developed a curved-cutting sternotomy device that eliminates the need for metal wires, aiming to improve precision and accelerate recovery. This project aims to address the information and innovation gap by developing a strategic go-to-market (GTM) plan for Healers, informed by market and ethnographic research. Healers is a subsidiary of Jinnovate.

## **Approach**

A mixed-methods approach was used, including secondary research and ethnographic interviews with surgeons. Key themes were identified through qualitative coding; competitor and industry analyses were conducted using tools like strength, weakness, opportunities, and threats (SWOT). Academic articles, market reports, and clinical guidelines (El-Ansary et al., n.d.; Kapstone Medical, n.d.) provided other data. Using all of our findings, we created audience profilers for our key stakeholders, including patients, cardiothoracic surgeons, insurance companies and hospital

systems. By understanding the concerns and priorities of each audience, we can craft targeted messaging, engagement tactics, and outreach strategies. No statistical testing was conducted; the project was marketing-focused.

## Findings

Five key findings emerged from our research: long and painful recoveries, risks from metal wires, challenges with reoperations, CPR-related complications, and overall dissatisfaction with existing methods. People expressed interest in safer, wire-free alternatives, which displayed a strong need for Healers' device in the market. Market research showed over 700,000 annual sternotomies in the U.S. alone (Song et al., 2023), highlighting significant need and opportunity.

## Conclusions and Recommendations

There is strong support for Healers' innovations. These findings support a targeted GTM strategy focused on clinical impact and commercial potential. To move forward, we recommend pilot testing, regulatory planning, and awareness-building among surgeons. With proper execution, Healers can improve patient outcomes and set a new standard in sternotomy care (Engelman et al., 2019; Huh et al., 2020).

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# Beyond the Classroom: Shaping Student Identity Online

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## ***Sagarika Shrestha***

M.S. in Digital Marketing and Media

## ***Faculty Mentor***

Joseph Panzarella, M.A.

## **Introduction**

In today's fast-moving digital world, social media has become a core part of how universities communicate with their students. While past research has shown that these platforms can help boost student engagement (Mazer, Murphy, & Simonds, 2007), support international students (Heiberger & Harper, 2008), and act as informal "third places" for social and academic connection (Oldenburg, 1991; Baker-Eveleth et al., 2005), there's still a lot we don't know about how universities can use social media in more strategic and inclusive ways. This is especially important when thinking about how to build community, keep students informed, and make sure diverse voices are represented, particularly for groups that often feel overlooked, like international students. This project explores how universities use social media to create a sense of belonging. It also examines what strategies strike a good balance between formal messaging and genuine engagement, and what barriers might be getting in the way. The goal is to better understand how these digital platforms can be used not just for announcements, but as tools for meaningful connection. Concepts like "third places," community-building, and inclusive representation provide the foundation for this exploration, all within the broader context of digital communication in higher education.

## Method

To explore how students engage with university social media platforms and how these platforms impact their sense of community and representation, a survey-based approach was used. The survey included a mix of multiple-choice, Likert scale, and open-ended questions that focused on five key areas: how students use university social media, how often and in what ways they engage with content, how effective they find it for getting updates and resources, whether they feel represented, and what suggestions they have for improvement. Participants were recruited through university communication channels, including social media announcements. A snowball sampling strategy was used, encouraging participants to share the survey with peers. Quantitative data were analyzed using basic descriptive statistics to spot trends, while open-ended responses were reviewed and coded to identify common themes.

## Results

A total of 78 students completed the survey. Most participants (73.1%) were graduate students, with undergraduates (17.9%) and a small number of alumni (2.6%) also represented. Notably, 85.9% of respondents identified as international students, providing valuable insights into the experiences of a group that often navigates unique challenges in higher education. Most respondents (91%) reported following at least one of their university's official social media accounts, with Instagram being the most used platform (65.4%), followed by Facebook and LinkedIn. About 43.6% said they engaged with university-related content multiple times per week, with campus events (80.3%), academic updates (61.8%), and student achievements (60.5%) being the most interacted-with topics. When asked about social media's impact on their sense of connection to the university, 63.7% agreed that it helped foster a sense of community, and just over half (51.9%) rated it as a very effective tool for accessing updates and resources.

In terms of creating social connections, many students described social media as a space where they could stay in the loop and feel part of the campus community—especially important for those who may not be physically present or are new to the university environment. However, when it came to feeling represented, only 18.2% felt that the university's social media con-

tent adequately reflected their backgrounds and experiences. Open-ended responses emphasized a desire for more inclusive content and greater visibility of student diversity through things like user-generated posts.

Some challenges also came up. Around 42.6% of respondents said privacy was a concern when interacting with university-affiliated content, and 45.3% mentioned they tended to skip or ignore lifestyle-related posts that didn't feel relevant to them. Despite these concerns, the overall tone from respondents was that social media is an important and helpful communication tool, especially when it comes to staying informed and connected.

### **Conclusions and Recommendations**

This study confirms that social media plays a vital role in the student experience, particularly in fostering engagement and a sense of belonging, especially among international students. Platforms like Instagram and Facebook are not just communication tools; they serve as virtual "third places," where students find community, stay informed, and feel connected to campus life beyond formal academic settings. Less than one in five students felt their backgrounds were well represented in the content their universities share, pointing to a disconnect between institutional messaging and the actual diversity of the student body. Privacy concerns and low engagement with certain types of content also suggest that universities need to be more intentional in how they communicate online.

Moving forward, institutions should consider making space for more student voices, particularly through user-generated content, collaborations with student groups, and stories that reflect a wider range of experiences. More interactive content, like polls or Q&A sessions, could also make students feel more involved. And while social media analytics are often underutilized in higher ed, they could help universities fine-tune their strategies based on what students are responding to. Future research might focus on how specific types of content shape student identity and belonging, or on how to make social media more accessible and engaging for students who don't see themselves reflected in current narratives. Ultimately, social media holds real potential to support community-building and inclusion, but only if universities use it with intention, accountability, and a genuine commitment to representing all students.

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# Hilton NY Fashion District: AI-Driven Reputation Marketing Strategy

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## ***Mansi Kamboj***

M.S. in Digital Marketing and Media

## ***Faculty Mentor***

Larry Cohen, MBA

## **Introduction**

Online reputation plays a critical role in hospitality, yet existing research rarely combines AI-driven sentiment analysis, visual branding, and SEO strategy. Most studies treat these areas separately, leaving a gap in integrated, data-driven approaches to brand management (Cooper, Barber, & Griffin, 2020). This project explores whether AI tools—Google NLP, Vision API, and SEO audits—can collectively improve Hilton NY Fashion District’s reputation. The aim is to assess how guest sentiment, visual perception, and search visibility influence brand positioning and offer insights for reputation enhancement.

## **Approach**

This project used a qualitative, AI-assisted analytical approach to assess Hilton NY Fashion District’s online reputation. Guest reviews from public platforms served as the data source for sentiment analysis using Google Natural Language Processing (NLP), which categorized sentiments into positive, neutral, and negative. Google Vision API was applied to guest-uploaded images to extract dominant visual themes. SEO performance was evaluated through meta tag analysis and Google My Business data using tools from Moz. No human subjects were involved. Data was analyzed thematically, focusing on patterns in sentiment distribution, visual branding, and online visibility to generate actionable insights.

## Findings

Sentiment analysis of guest reviews showed that 55% were positive, 25% neutral, and 20% negative, indicating generally strong guest satisfaction with some areas for improvement. Visual branding insights revealed that recurring image tags included “Rooftop View” and “Modern Design,” reinforcing Hilton NY Fashion District’s upscale positioning, while tags like “Room Interior” and “Bathroom” appeared less frequently. SEO data showed that most brand mentions came from Google My Business and meta tags, with relatively low visibility from organic sources such as guest reviews and blog posts. These findings highlight strengths in branding and location, but suggest improvement areas in interior aesthetics, pricing clarity, and digital engagement.

## Conclusions and Recommendations

The study shows that AI tools like sentiment analysis, visual tagging, and SEO audits can effectively support reputation management in hospitality. While Hilton NY Fashion District performs well in guest satisfaction and branding, areas like room design, pricing clarity, and organic engagement need attention. Limitations include reliance on public data and minimal competitor analysis. Future work should include internal feedback and broader benchmarking to refine the strategy.

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# Occupational Therapy



*Arielle Caplan*



*Bella Chilczuk*



*Lior Nissanian*



*Briana Tucci*

# Disability Status, Cognitive Functioning, and Self Care Among People with Multiple Sclerosis

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## ***Arielle Caplan***

Occupational Therapy Doctorate

## ***Faculty Mentors***

Marissa Barrera, PhD, MSCS, CCC-SLP

Gioia Ciani, OTD, MSOT, OTR/

## **Introduction**

Multiple sclerosis (MS) is a neurodegenerative condition which impacts an individual's physical and cognitive function. The disease course varies, resulting in a range of function and ability across patient populations (Goldenberg, 2012). This calls for clinicians to use valid measures to assess MS impact on daily function. The Expanded Disability Status Scale (EDSS) is widely used by neurologists to assess the level of disability but is criticized for many limitations, including its focus on ambulation. Cognition and self-care ability, are omitted or poorly represented in the EDSS (Lynch et al., 2021). This study explores the relationship between EDSS scores with self-care scores, measured by the Physical Self-Maintenance Scale (PSMS) and EDSS scores with cognitive scores, measured by NeuroTrax computerized assessment. The outcomes of these analyses shed light on the EDSS's ability to accurately measure the impact of MS symptoms on self-care and cognitive functioning.

## **Method**

A retrospective study was conducted with data collected from a neurologic clinic. One hundred and sixty patients fit the study criteria. These included an MS diagnosis, completion of relevant measures (EDSS, PSMS, and NeuroTrax), and absence of neurologic comorbidities, cancer, or preg-

nancy. Participants were majority female, 69.4% (n = 111), and ranged in age from 19 to 71. All procedures took place during routine care. First, participants completed the PSMS self-care assessment. Next, test technicians administered NeuroTrax, which tested seven cognitive domains. A certified rater administered the EDSS. Pearson and Spearman correlations were computed using IBM SPSS with p-value set for < .05.

**Results**

A moderate correlation was found between EDSS and PSMS,  $r_s = -.39, p < .001$ . Additionally, a low correlation was found between EDSS and total cognitive score,  $r = -.29, p < .001$ . The correlations between EDSS scores and each cognitive domain are shown in Table 1.

**Table 1**  
*Pearson Correlation Between Disability and Cognition in Each Domain*

NeuroTrax	EDSS
Executive function	-.31**
Attention	-.30**
Information processing speed	-.27**
Memory	-.21*
Visual spatial	-.22*
Verbal function	-.07
Motor skills	-.24*

*\*Correlation is significant at the 0.05 level (2-tailed);*

*\*\*Correlation is significant at the 0.01 level (2-tailed)*

**Conclusions and Recommendations**

Disability status, as represented by EDSS scores, relates to self-care capacity and cognitive functioning. However, EDSS scores may not adequately reflect the specific contributions of self-care and cognitive impairments to

overall disability. The weak correlations observed between EDSS scores and both NeuroTrax and PSMS scores suggest that changes in cognitive or self-care functioning may not be accurately captured by the EDSS. To enhance the generalizability of findings, future research should consider recruiting participants from a diverse range of clinical settings nationwide. Additionally, alternatives to PSMS and NeuroTrax should be considered for future research on self-care and cognition in people with MS. Recommendations include that neurologists incorporate complementary measures of disability, while occupational therapists (OTs) assess self-care and cognitive functioning in individuals with MS to provide a more comprehensive understanding of overall functioning. The development of an MS-specific self-care assessment tool could further assist OTs in identifying the impact of MS-related symptoms on daily functioning and in tailoring intervention strategies accordingly.

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# Promoting Family Resilience: Tier-1 Strength-Based Program to Enhance Parent-Child Play Interactions

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## ***Bella Chilczuk***

Occupational Therapy Doctorate

## ***Faculty Mentor***

Amiya Waldman-Levi, PhD, OTR/L, FAOTA

## ***Collaborators***

Sarah Fabrizi, PhD, OTR/L FAOTA, Zoe Hill, Gabriella Tavory

## **Introduction**

Socioeconomic inequities have a direct effect on child development leading to poorer health, lower verbal and cognitive ability, and emotional/behavioral problems (Doyle et al., 2009). Despite the central role of play in child development, parents struggle to effectively use play to support their children's development (Jeong et al., 2021). Parents' participation in playing with their children enhances the parent-child relationship (Román-Oyola et al., 2023). Current interventions frequently overlook the potential of strength-based approaches centered on play (Wilson, 2021). This pilot study aimed to explore how a strength-based intervention focused on play can improve parental competency and positively influence child development.

## **Method**

This paper describes a pilot, two-group, pre-and-post study part of a mixed methods study approved by WCG add protocol number. Parents of neurotypical and neurodiverse children aged 2 to 5 were recruited through convenience sampling methods. Parents who met study inclusionary criteria

were invited to complete the consent procedure and a set of questionnaires: background, Parental Sense of Efficacy (PSOC), and Parent/Caregiver's View of Supporting Children's Play and Playfulness (PCV-SCP). Parents were assigned to either an intervention groups receiving two online information sessions on promoting child development through playful interactions, child advocacy, and parental stress management strategies or a control/waitlist group. Post-program questionnaires were readministered.

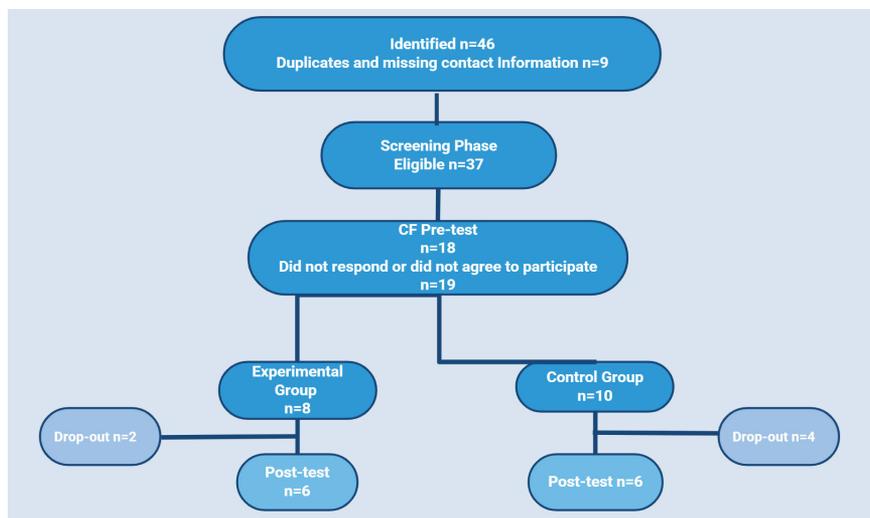
## Results

Twelve parents completed this pilot study; retention is illustrated in Figure 1. (experimental:  $M = 2.71$ ,  $SD = 0.38$ ; control:  $M = 2.50$ ,  $SD = 0.08$ ),  $U = 6$ ,  $p = .065$ . Changes in pretest satisfaction and efficacy scores can be seen in Table 2 highlighting an increase in posttest satisfaction scores between the experimental ( $M 5.43$ ,  $SD 0.76$ ) and control ( $M 5.33$ ,  $SD 0.73$ ).

## Conclusions and Recommendations

There are trending positive effects of the **Tier-1 Strength-Based Program** on parents' perceptions of supporting play as well as parental self-efficacy suggesting potential with a larger sample size. The results demonstrate that providing parents with a tier-1 strengths-based program increases their ability to support their child's play. Limitations: small sample size, participant retention, and reliance on self-report measures. Promoting family resilience and child development can be achieved through low-cost, accessible programming.

**Figure 1**  
*Flow Chart*



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# Resource for Dental Professionals Providing Care to Individuals with Autism Spectrum Disorder (ASD) Through Sensory and Environmental Modifications

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## ***Lior Nissanian***

Occupational Therapy Doctorate

## ***Faculty Mentor***

Amiya Waldman-Levi, PhD, OTR/L, FAOTA

## **Introduction**

In recent decades there has been a drastic increase in autism spectrum disorder (ASD) with a prevalence of every 1 in 36 children (National Institute of Health, 2022). Individuals with ASD represent a severe concern to dentistry due to the considerable difficulty in managing their oral health, maintaining routine toothbrushing, and preventing dental and periodontal problems (Zerman et al., 2022). This is in part due to difficulties with sensory processing which affects 91% of individuals with ASD leading to avoidance of care, non-compliance, uncooperative behavior and lack of knowledge by the dental professional on how to treat this population (Alumran et al, 2018; Como et al, 2020; Corridore et al, 2020; Erwin et al., 2022). This projects' overarching goal is to create an educational resource for dental professionals aiming to provide evidence-based occupational therapy (OT) resources consisting of strategies as well as preparatory protocols to increase likelihood of a positive visit for both the provider and client.

## **Approach**

A literature review was first conducted and affirmed multiple barriers to care and accessibility for the ASD population in the dental settings and minimal resources to combat these barriers. This then set into motion

development of a resource that can provide education regarding ASD (i.e., diagnosis, severity, presentation, and common comorbidities), a deeper understanding of sensory processing disorders (types and presentation), and most importantly, evidence based tools and strategies frequently used by OTs that dental professionals can implement in the dental setting. Concurrently, participants for an expert OT panel were recruited for evaluation of the resource. They completed a pre-evaluation form to confirm qualifications, followed by a post-evaluation survey that included multiple-choice questions assessing content flow, clarity, and relevance, along with open-ended questions for detailed feedback.

### **Outcomes**

The results from the expert OT panel highlighted valuable insights and areas for refinement. Both experts had over 20 years of experience in sensory processing and working with children diagnosed with ASD in pediatric settings. In the quantitative portion of the evaluation, both affirmed the clarity and logical flow of the content, indicating that the resource demonstrates strong potential to support dental professionals in working effectively with the ASD population. However, both experts identified minor issues related to grammar and syntax and recommended revisions to improve the readability and precision of the material. In the qualitative section, they offered additional suggestions aimed at enhancing the overall quality, relevance, and accessibility of the resource for its target audience.

### **Conclusions and Recommendations**

This project faced limitations, including time constraints and the absence of a formal needs assessment, with the need instead identified through gaps in existing research. A small sample size of occupational therapists and dental professionals also limited generalizability. Despite this, the resource shows strong potential to enhance interprofessional collaboration between OT and dentistry, improving care for individuals with ASD. OTs offer valuable strategies for managing sensory challenges, which can help dental professionals reduce anxiety and uncooperative behaviors in patients with ASD. Future steps include expanding feedback, revising the resource, and conducting a pilot study to assess its effectiveness in clinical settings.

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# Steady Steps Outdoors: An Outdoor Fall Prevention Program

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## ***Briana Tucci***

Occupational Therapy Doctorate

## ***Faculty Mentor***

Alexandra Laghezza, Ph.D., OTR/L, Clinical Assistant Professor

## **Introduction**

Falls have a high prevalence in older adults, with 50% of falls occurring outdoors in their communities (Kelsey et al., 2010). Most adults over 60 are unaware of outdoor risk factors and their differences from indoor risk factors (Chippendale, 2019). Current fall prevention research and programs mainly focus on indoor falls, leaving a gap in knowledge on outdoor risk factors. This project aims to develop a outdoor fall prevention and community mobility program specifically targeting outdoor environments, along with a resource sheet to help occupational therapy practitioners better support their older adult clients

## **Procedure**

Both the fall prevention program and resource sheet followed similar processes. A literature review examining the current outdoor fall prevention program was followed by development of a program and resource sheet based on up-to-date evidence. We then enlisted preliminary feedback about the research sheet and program; 16 occupational therapy practitioners (OTPs) were asked to provide feedback, while the program was delivered to 9 older adults as a free service and asked for their input. The resource sheet given to the OTP was four pages and included the most recent relevant information for OTPs on outdoor falls; the program was delivered in person in one session.

## Outcomes

The program was presented to nine female adults, ages 69-87. Over half (56.6%) had experienced an outdoor fall in the past year. After the program, 63.9% of participants demonstrated retained information and reported that it was relevant and useful in their daily outdoor activities. For the resource sheet, an expert panel composed of 16 OTPs responded to the survey. Of those, 64% had already addressed outdoor falls in their sessions. Sixty-seven percent expressed a desire to incorporate more outdoor fall prevention in their practices if provided with updated information regularly. Participants found it helpful to receive the resource sheet and were more likely to include the information in their practice.

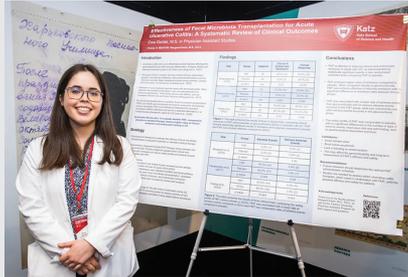
## Conclusion and Recommendations

The program successfully increased participants' knowledge and encouraged the application of fall prevention strategies in daily life. Presentations and discussions proved effective for learning, while the resource sheet provided OTPs with practical tools to support clients. Feedback demonstrated strong interest in continued education on outdoor fall prevention, highlighting the need for further research and clinical focus in this area. Limitations: female participant group, not all OTP completed post-survey.

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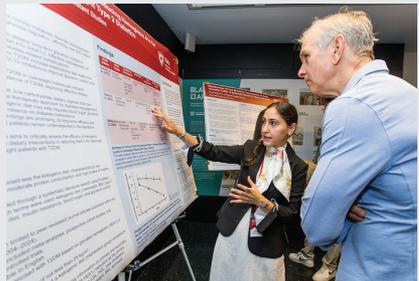
# Physician Assistant Studies



*Ewa Gerlak*



*Allison Moore*



*Ilana Rouhani*

# Effectiveness of Fecal Microbiota Transplantation in Adults with Active Ulcerative Colitis: A Systematic Review

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***Ewa Gerlak***

M.S. Physician Assistant Studies

***Faculty Mentor***

Margaret Ewen, M.S., PA-C

## **Introduction**

Ulcerative colitis (UC) is a chronic inflammatory bowel disease characterized by relapsing mucosal inflammation of the colon, leading to symptoms such as bloody diarrhea, abdominal pain, and fatigue, which significantly impair quality of life (Segal et al., 2021). The global prevalence of UC is rising, particularly in Western countries. Standardized treatments including aminosalicylates, corticosteroids, immunosuppressants, and biologics, are often accompanied by significant adverse effects and limited efficacy for some patients (Friedman & Blumberg, 2022; Caviglia et al., 2023). Recent evidence depicts gut microbiome imbalance as one of the causes of ulcerative colitis and therefore prompts interest at fecal microbiota transplantation (FMT) as a treatment strategy to restore microbiome diversity (Lee et al., 2016). This systematic review aims to determine whether FMT leads to higher rates of clinical and endoscopic remission, with fewer adverse events, compared to placebo or glucocorticoids.

## **Method**

A systematic review of randomized and controlled clinical trials published between 2014 and 2024 was conducted to evaluate the efficacy and safety of FMT versus placebo or glucocorticoids in adults with mild-to-moderately active UC with a Mayo score of 4 to 10) Literature searches were performed

in Medline-PubMed, Google Scholar, Academic Search Premier, and ScienceDirect. Inclusion criteria required studies to be peer-reviewed, conducted in adults ( $\geq 18$  years), and to report clinical and endoscopic outcomes. Primary endpoints were clinical and endoscopic remission, and secondary endpoints were adverse events. The selected studies were systematically screened for risk of bias by a single author.

## Results

A total of 22 studies were analyzed, with 19 excluded and 3 included in the final review. Studies were excluded based on publication date, with only those published within the past ten years considered, and studies that did not have fecal microbiota transplantation (FMT) as monotherapy as one of the cohort groups were also excluded. Across the three clinical trials reviewed, FMT demonstrated statistically significant higher rates of clinical and endoscopic remission compared to placebo in adults with active ulcerative colitis. For example, Moayyedi et al. (2015) found remission in 24% of FMT recipients versus 5% for placebo ( $p=0.03$ ), and Paramsothy et al. (2017) reported 27% remission with FMT versus 8% with placebo ( $p=0.021$ ), with clinical response rates of 39% and 54% for FMT, respectively, compared to 24% and 23% for placebo. Adverse events were similar between FMT and placebo groups in both studies, with most events being mild and self-limiting and no significant difference in serious adverse events. In the trial by Huang et al. (2022), FMT achieved comparable remission rates to glucocorticoids (54.8% vs 48.3%,  $p=0.59$ ), but was associated with significantly fewer adverse events (22.6% vs 60%,  $p<0.001$ ) and no serious adverse events in the FMT group, while two patients in the glucocorticoid group required colectomy.

## Conclusion and Recommendations

This systematic review demonstrates that FMT is effective in inducing clinical and endoscopic remission in adults with active UC, showing statistically significant superiority over placebo and comparable efficacy to glucocorticoids with limited adverse events. Limitations of the current evidence include small sample sizes, short follow-up periods, and differences in study design and allowance for concomitant therapies. Future research should focus on larger, multicenter randomized trials with longer follow-up to assess remission, optimal FMT protocols, and patient selection criteria.

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# Safety and Efficacy of Topical Ruxolitinib Versus Topical Corticosteroids in the Treatment of Atopic Dermatitis: A Systematic Review of the Literature

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## **Allison Moore**

M.S. Physician Assistant Studies

## **Faculty Mentor**

Margaret Ewen, M.S., PA-C

## **Introduction**

Atopic dermatitis (AD) is a chronic inflammatory skin condition characterized by pruritus and xerosis due to underlying epidermal barrier dysfunction. While commonly managed with topical corticosteroids, long-term use can lead to adverse effects such as skin atrophy, immunosuppression, and steroid dependence. Janus kinase (JAK) inhibitors block proinflammatory cytokine signaling and have demonstrated efficacy in AD but are typically available in systemic formulations. Topical ruxolitinib (RUX), a JAK1/JAK2 inhibitor, offers a novel steroid-sparing approach with potential for fewer systemic effects. The aim of this systematic review was to evaluate the safety and efficacy of topical RUX versus corticosteroids in managing mild to moderate AD. Clinical outcomes of interest included Eczema Area and Severity Index (EASI), Investigator's Global Assessment (IGA), percentage body surface area (%BSA), and overall itch relief.

## **Methods**

A systematic review was conducted using PubMed, Google Scholar, ScienceDirect, ClinicalTrials.gov, and Access Medicine to identify peer-reviewed studies published from 2014 to 2024. Search terms included “atopic dermatitis,” “ruxolitinib,” “JAK inhibitor,” and “topical corticosteroids.”

Inclusion criteria were randomized controlled trials, open-label studies, or meta-analyses comparing topical RUX to vehicle or corticosteroids in human subjects. Exclusion criteria included studies on systemic JAK inhibitors or non-comparative studies. One author screened titles and abstracts, reviewed full texts, and extracted relevant data. Primary outcomes were EASI, IGA, %BSA, and itch-NRS scores; secondary outcomes included adverse events and systemic absorption.

## **Results**

From over 200 initial results, three clinical studies (n = 419 total participants) met the inclusion criteria. Across studies, topical RUX significantly improved EASI (up to 71.6% reduction), IGA (up to 38% IGA success rate), BSA, and itch-NRS ( $\geq 4$ -point reduction in some groups) compared to vehicle and active controls. Improvements were observed as early as 36 hours post-treatment in some studies. In Kim et al. (2020), RUX 1.5% BID outperformed 0.1% triamcinolone in both EASI (71.6% vs. 15.5%) and IGA (38% vs. 7.7%) ( $p < .0001$ ). Bissonnette et al. (2022) demonstrated 94.6% of patients achieved  $\geq 75\%$  EASI improvement after 56 days. Adverse events were mild to moderate and included application site reactions in  $<10\%$  of participants. Plasma concentrations of RUX remained below thresholds associated with systemic immunosuppression.

## **Conclusion and Recommendations**

Topical RUX demonstrates comparable or superior efficacy to mid-potency topical corticosteroids in reducing AD severity, with a favorable safety profile and low systemic absorption. Its use may benefit patients requiring long-term management or those at risk of steroid-related side effects. Limitations of this review include the small number of eligible studies, short treatment durations, and heterogeneity in study design. Future research should include longer-term trials, diverse patient populations, and comparisons to various corticosteroid potencies to support RUX's incorporation into standard AD treatment protocols.

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# Efficacy of the Ketogenic Diet in Reducing Hemoglobin A1c in Overweight Type 2 Diabetics: A Systematic Review

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***Ilana Rouhani***

M.S. Physician Assistant Studies

***Faculty Mentor***

Margaret Ewen, M.S., PA-C

## **Introduction**

Type 2 diabetes mellitus (T2DM) is a global health challenge, affecting over 500 million people worldwide. Standard treatments for T2DM include medications and lifestyle changes. The ketogenic diet, a high-fat, low-carbohydrate regimen, has been proposed as a means to improve glycemic control by promoting ketosis, weight loss, and reducing diabetes medication dependence. This systematic review examines the efficacy of ketogenic diets in improving HbA1c levels among overweight T2DM patients, compared to other dietary approaches.

## **Method**

A systematic literature search was conducted using PubMed. Studies included meta-analyses, randomized controlled trials, and cohort studies published between 2004 and 2024. The inclusion criteria required participants to have T2DM, a BMI of  $\geq 25$  kg/m<sup>2</sup>, and follow a ketogenic diet or another dietary intervention. The primary outcome measured was HbA1c, with secondary outcomes such as body weight, BMI, fasting glucose, and lipid levels.

## Results

Three studies indicated significant improvements in glycemic control with the ketogenic diet compared to other diets. For example, Hussain et al. (2012) found a significant reduction in HbA1c from 7.8% to 6.3% in the ketogenic diet group, compared to 8.2% to 7.625% in the low-calorie diet group. Similarly, Goday et al. (2016) reported a significant reduction from 6.89% to 6.0% for the ketogenic diet group, with a greater weight loss compared to the low-calorie group. Westman et al. (2008) demonstrated that HbA1c in the ketogenic diet group decreased from 8.8% to 7.3%, outperforming the low-glycemic index diet.

## Conclusion

This review highlights the effectiveness of the ketogenic diet in managing type 2 diabetes mellitus (T2DM) by significantly lowering HbA1c levels and promoting weight loss. However, challenges related to dietary adherence and possible side effects, including gastrointestinal discomfort, must be taken into account. Despite these promising outcomes, limitations such as small sample sizes and study design biases may affect the validity of the findings. Healthcare providers should consider a personalized treatment plan, while future research with larger sample sizes and longer follow-up periods is essential to confirm the long-term efficacy, sustainability, and safety of the ketogenic diet in the management of T2DM.

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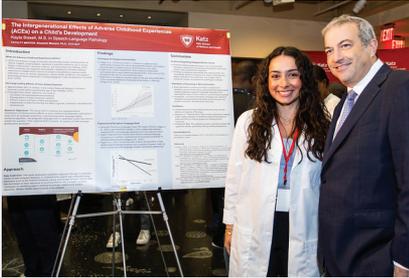
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# Speech-Language Pathology



*Kayla Bissel and Rabbi Dr. Ari Berman,  
Yeshiva University President*



*Samantha Golin*



*Sharon Matalon and Dr. Marissa  
Barrera, Assistant Dean and Director,  
M.S. in Speech-Language Pathology*



*Genevieve Shaffer*



*Brooke Smith*

# The Intergenerational Effects of Parental Adverse Childhood Experiences (ACEs) on a Child's Development

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## ***Kayla Bissell***

M.S. in Speech-Language Pathology

## ***Faculty Mentor***

Elisabeth Mlawski, Ph.D., CCC-SLP

## **Introduction**

Adverse Childhood Experiences (ACEs) include traumatic events such as abuse, neglect, household dysfunction, and exposure to violence or parental mental illness (Crandall et al., 2019). Studies show a strong link between multiple ACEs and increased risk for negative health outcomes like obesity, depression, and chronic illness. While early research focused on adult health, emerging evidence highlights parental ACEs as a significant risk factor for developmental delays in children. This study explores how intergenerational trauma impacts early childhood development, including language, emotional regulation, behavior, and social skills.

## **Approach**

This study employed a qualitative approach through a systematic review of peer-reviewed literature. A comprehensive search was conducted using scholarly databases such as Yeshiva University Library and Google Scholar. Articles were selected based on their relevance to recurring themes, key concepts, and their contribution to identifying gaps in existing knowledge related to the study's objectives. Seventeen articles were included in the analysis.

## **Findings**

Language is the foundation for learning, social connections, and self-

expression, yet early exposure to adversity significantly disrupts its development. Riggs et al. (2021) identified a direct link between higher maternal ACEs scores and lower early language skills, marking a key intergenerational finding. Similarly, Folger (2018) reported an elevated risk of developmental delays—particularly in the domains of communication and problem-solving—among children whose parents had experienced three or more adverse childhood experiences (ACEs). Maternal ACE exposure has also been associated with difficulties in children’s emotional regulation and social communication. For instance, McDonnell and Valentino (2016) found that maternal ACEs were linked to increased socioemotional challenges, including insecure attachment in infants. Likewise, Sun et al. (2017) observed a heightened likelihood of developmental risk among children of mothers with high ACE scores compared to their peers.

### **Conclusion and Recommendations**

The research on parental ACEs highlights the profound intergenerational impact on early childhood development, particularly in language acquisition, socio-emotional regulation, and overall developmental milestones. One major limitation is that most studies focus primarily on maternal ACEs; further research is needed to examine the impact of paternal ACEs on children’s language and developmental outcomes. By prioritizing early intervention and family-centered support systems, clinicians and policymakers can help break the cycle of adversity, fostering resilience and promoting healthier developmental trajectories for future generations

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# Exploring Avoidant Restrictive Food Intake Disorder (ARFID): A Multi-Factor Approach

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## ***Samantha Golin***

M.S. in Speech-Language Pathology

## ***Faculty Mentors***

Marissa A. Barrera, Ph.D., MSCS, CCC-SLP

Kathleen Fitzgerald, M.S., CCC-SLP

## **Introduction**

Restrictive Food Intake Disorder (ARFID) is a diagnostic term introduced in the DSM-5 (2013) describing an eating disorder characterized by restricted intake of food that is not related to body image concerns. Individuals with ARFID often fail to meet appropriate nutritional and energy needs, which can result in significant physical and psychosocial challenges. The disorder typically presents itself in three main ways: sensory-based food avoidance, fear of aversive consequences (e.g., choking or vomiting), and a general lack of interest in eating (Kambanis et al., 2019). ARFID commonly co-occurs with conditions such as anxiety, Autism Spectrum Disorder (ASD), and gastrointestinal disorders, yet the full scope of its etiology remains underexplored.

## **Strategy**

This project aims to enhance the understanding of ARFID by examining its biological, sensory, and comorbid components. A systematic review of current literature was conducted using a qualitative data analysis approach. Articles were sourced from databases like Google Scholar and PubMed, and selected based on their relevance to ARFID, empirical rigor, and peer-reviewed status.

## Findings

Findings suggest that ARFID may have strong biological, genetic, and neurological foundations. Research indicates a possible genetic overlap between ARFID and other neuropsychiatric disorders, such as eating disorders and anxiety-related conditions (Dinkler et al., 2023). Sensory processing differences also play a critical role, particularly in children with sensory sensitivities who show rigid preferences and heightened aversions to the texture, smell, or appearance of certain foods.

Additionally, studies on comorbidity (e.g., Zimmerman et al., 2017) reveal that ARFID often occurs alongside other disorders and should not be viewed in isolation. Understanding these comorbid relationships is essential for accurate diagnosis and effective treatment. Differentiating short-term ARFID—often triggered by specific events such as choking—from chronic, long-term ARFID can further help tailor intervention strategies.

## Conclusion and Recommendations

Given the complexity of ARFID, a multidisciplinary approach is essential. Collaboration among professionals can enhance screening tools, support earlier interventions, and lead to better outcomes. Future research should focus on biological and genetic markers, sensory-based therapies, and the development of standardized, evidence-based treatments.

More large-scale, longitudinal studies are needed to improve diagnosis, treatment planning, and long-term outcomes. Ultimately, greater awareness and a stronger evidence base will enable more effective clinical care for individuals with ARFID.

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# Maximizing Speech Outcomes in Children with ASD: Group vs. Individual Therapy

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## ***Sharon Matalon***

M.S. in Speech-Language Pathology

## ***Faculty Mentors***

Michaela Medved, MA, TSSLD, CCC-SLP, ClinScD, PhD

## **Introduction**

Articulation deficits are a prevalent concern among school-aged children with Autism Spectrum Disorder (ASD), frequently affecting speech intelligibility and hindering classroom engagement. School-based speech-language pathologists (SLPs) must determine the most effective service delivery model—individual or group therapy—each of which presents distinct advantages and limitations. This project investigated the influence of therapy format (group vs. individual) and the severity of articulation deficits on treatment outcomes, with a specific focus on gains in expressive speech sound accuracy.

## **Strategy**

A literature review was conducted using scholarly databases including Google Scholar, ASHAWire, and the YU library. Keywords included: “ASD,” “articulation deficits,” “speech sound disorders,” “group therapy,” and “individual therapy.” Inclusion criteria focused on peer-reviewed articles addressing articulation interventions in school-aged children with ASD. Eighteen studies were reviewed in total, with five selected for a research poster based on relevance and strength of evidence. Articles were analyzed for treatment format, participant severity levels, and therapy outcomes.

## Findings

Findings revealed that individual therapy is particularly effective for children with severe articulation deficits due to its highly personalized and targeted nature (Farquharson et al., 2020). In contrast, children with mild to moderate deficits benefited equally from group therapy, which offered opportunities for peer modeling and generalization (Boyle et al., 2007; Sommers et al., 1966). Additionally, studies supported that both therapy types, when structured and consistent, can significantly improve speech production in children with ASD (Petinou, 2021; Watt & White, 2018).

## Conclusions and Recommendations

Therapy format should be determined based on the child's articulation severity and individual needs. Group therapy offers a resource-efficient model that can promote social communication and generalization for children with less severe speech needs. However, individual therapy remains crucial for those requiring intensive support. School-based SLPs should use a flexible, evidence-based approach to determine service delivery, while future research should continue exploring hybrid models and long-term outcomes.

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# Shaping Androgynous Voice: Bridging the Research Gap in Gender-Affirming Voice Therapy

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## ***Genevieve Shaffer***

M.S. in Speech-Language Pathology

## ***Faculty Mentors***

Genevieve Shaffer

## **Introduction**

Voice is a key feature of gender identity and expression. While the literature provides well-established acoustic norms for binary genders (e.g., pitch, resonance, prosody), there is a lack of consensus on how to define and measure androgynous voices (Adessa et al., 2023; Gelfer & Mikos, 2005). Research suggests that androgynous voices may incorporate masculine and feminine traits or represent a distinct, perceptually neutral vocal profile (Papeleu et al., 2022). The clinical implications are significant, as this ambiguity challenges speech-language pathologists in gender-affirming care. This project aims to synthesize current acoustic and perceptual data to define androgynous voice characteristics and support the development of in-demand, evidence-based frameworks for patients seeking intervention.

## **Approach**

A systematic review methodology was used to identify and analyze peer-reviewed studies on androgynous, nonbinary, and gender-diverse voice production. Both quantitative (e.g., acoustic measures of pitch, resonance, formants) and qualitative (e.g., self-perception reports, clinician perspectives) data were included. Studies were coded and thematically analyzed to identify patterns in pitch range, speech rate, prosody, and vowel formant frequency. Listener-perception data were also examined to assess how vocal ambiguity correlates with acoustic features. Qualitative data were analyzed using thematic coding frameworks.

## Findings

Findings reveal that pitch remains a central but insufficient marker of vocal gender. Masculine voices typically fall within 85-155 Hz, feminine voices with 165-255 Hz, and androgynous voices in the 165-187 Hz range (Watson, 2019). However, pitch alone cannot account for gender perception, as vowel formants—particularly the first three (F1, F2, and F3)—carry significant perceptual weight. F1 corresponds primarily to vowel height (how open or closed the mouth is), while F2 reflects vowel backness (how far forward or back the tongue is positioned). F3, is often associated with vocal tract characteristics such as lip rounding and pharyngeal width and may contribute to perceptions of vocal clarity or resonance. The chart below shows that overlapping F2 and F3 values for male and female speakers contribute to perceptual ambiguity in vowel resonance (Gelfer & Bennett, 2013). Intonation patterns among nonbinary speakers often blend masculine and feminine cues (Schmid & Bradley, 2019). Speech rate also differs slightly by gender, with men speaking faster on average (Jacewicz et al., 2009). Across studies, androgynous voices occupied an overlap zone between binary norms or exhibited distinct features not aligned with either end of the spectrum.

**Table 1**  
*Overlapping Vowel Formant Frequency Ranges  
for Male and Female Speakers*

Vowel	Formant	Male Range (Hz)	Female Range (Hz)	Overlap (Hz)
/i/	F1	203.87-327.31	290.83-443.82	290.83-327.31
/i/	F2	1947.7-2691.15	2087.25-2942.9	2087.25-2691.15
/i/	F3	2734.05-3292.4	2934.15-3715.93	2934.15-3292.4
/a/	F1	698.81-989.02	811.46-1149.46	811.46-989.02
/a/	F2	1226.78-1747.18	1359.33-1627.98	1359.33-1627.98
/a/	F3	2346.95-2891.6	2537.68-3437.06	2537.68-2891.6

(Gelfer & Bennett, 2013)

The most significant overlap occur in the F2 and F3 ranges for both vowels, with smaller overlap in the F1 range. These overlaps contribute to potential ambiguity in gender perception based on vowel formants alone.

## Conclusions and Recommendations

This review underscores the complexity of defining an androgynous voice and critiques the limitations of applying binary vocal norms to nonbinary individuals. The findings emphasize the importance of individualized, client-centered approaches in gender-affirming voice therapy. Small sample sizes, inconsistent acoustic parameters, and limited validation through listener-based assessments constrain current research. Future studies should prioritize the development of norm-referenced datasets and interdisciplinary models that integrate voice science, endocrinology, and mental health. Additionally, speech-language pathology training must evolve to reflect these emerging frameworks and better support the needs of nonbinary clients.

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# The Correlation of Executive Function and PTSD in Veterans: The Role of Medical Speech-Language Pathologists

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## **Brooke Smith**

M.S. in Speech-Language Pathology

## **Faculty Mentors**

Marissa Barrera, PhD, Assistant Dean of Health Sciences, Program Director, Associate Professor, Graduate Program in Medical Speech Language Pathology

## **Introduction**

Post-Traumatic Stress Disorder (PTSD) affects veterans psychologically *and* cognitively, with growing recognition of its impact on executive function (EF). Over the past few decades, the medical speech-language pathology community has been defining a direct link between PTSD and its impacts on EF. EF encompasses a set of cognitive skills, including decision-making, cognitive flexibility, and problem-solving. Veterans with PTSD frequently report impairments in these areas, which can hinder their ability to engage effectively in social situations, maintain employment, and sustain functional independence (Riley et al., 2019).

## **Findings**

Literature demonstrates a strong link between PTSD and EF, with neuro-imaging research highlighting altered activity in the prefrontal cortex, hippocampus, thalamus, and limbic structures (Aupperle et al., 2012; Araújo et al., 2023). Cognitive performance is further compromised when PTSD co-occurs with conditions such as traumatic brain injury (TBI), substance use disorder (SUD), or cardiovascular disease (Norman et al., 2021), among

others. The presence of these comorbidities adds complexity to both diagnosis and treatment, thereby increasing the risk and severity of cognitive impairment.

Studies have found a connection to PTSD and long-term cognitive decline and neurocognitive disorders (NCD), including dementia. According to The Center for PTSD, veterans' risk for dementia is increased by 1.6 times when they have PTSD, and with that, their potentially dormant PTSD is at risk for reactivation if dementia develops. Clinically, EF impairments are often overlooked and under-reported.

### **Conclusions and Recommendations**

Medical Speech-Language Pathologists are trained to assess and treat cognitive communication disorders (CCD)—particularly EF impairments. Tools such as metacognitive strategies and goal management therapy help veterans develop compensatory techniques to meet their day-to-day goals. Despite the simplicity of these interventions, which are highly functional and relevant, SLPs are often excluded from PTSD treatment.

Veterans deserve comprehensive care that supports the development of their cognitive-communication abilities. Individuals with PTSD frequently experience cognitive-communication breakdowns that adversely affect their quality of life (Polak et al., 2012). Addressing executive function (EF) deficits—particularly when compounded by comorbid conditions—requires a coordinated, interdisciplinary approach. Future research should prioritize the development and evaluation of speech-language pathologist (SLP)-led interventions to optimize rehabilitation outcomes for veterans.

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