



Helping Transgender Individuals Find Their Voice

Final Presentation

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Harvard Medical School

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Sara – A Case Study



- 23-year-old transgender female (male-to-female)
- Struggles to align masculine-presenting voice with feminine identity
- Not satisfied with own voice in public settings
- **Not interested** in surgery to elevate vocal pitch
- Finds voice therapy sessions **hard to follow up** with practice exercises at home
- Her practice experience is **not motivational**

Voice Dysphoria

Definition

- Perceived mismatch between one's outward vocal presentation and gender identity

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Impact

- Anxiety, depression, sadness, frustration
- Feeling self-conscious while speaking in public
- Difficulty articulating thoughts in public
- Isolation and avoidance of others
- Reduced sleep and appetite
- Suicidal ideation

U.S. Transgender Population

Total U.S. Transgender Population:

1.6M

1.3 M adults (ages 18 and older)

0.3 M youth (ages 13 to 17)

0.4% of U.S. population

35.9%

Transgender men

38.5%

Transgender women

25.6%

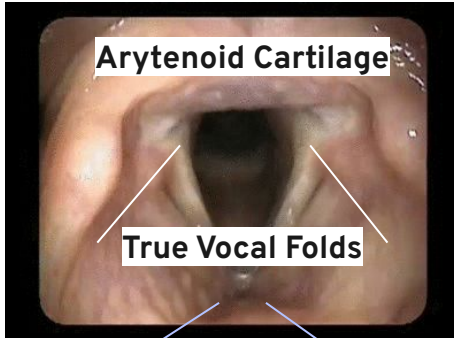
Transgender nonconforming

Problem

- **Voice dysphoria** afflicts many transgender individuals, especially transfemales, who are dissatisfied with their voice
- The limited voice modification apps that are available for voice dysphoria in the transgender population are **not well-designed, comprehensive, or customizable**

Voice Synthesis

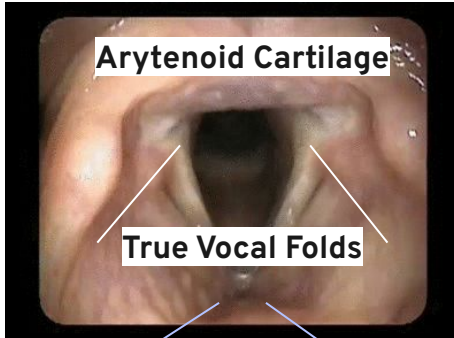
1. Vibratory Source



False Vocal Folds

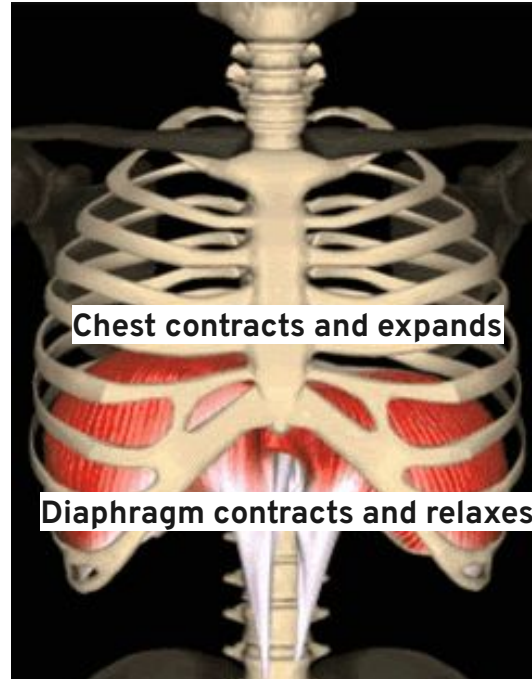
Voice Synthesis

1. Vibratory Source



False Vocal Folds

2. Power Source

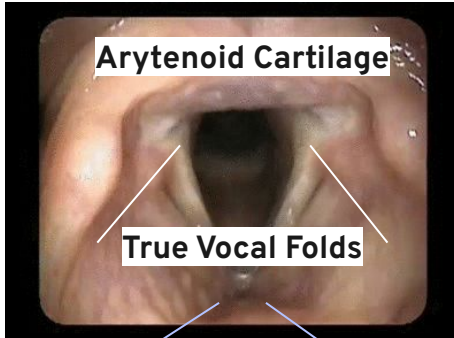


Chest contracts and expands

Diaphragm contracts and relaxes

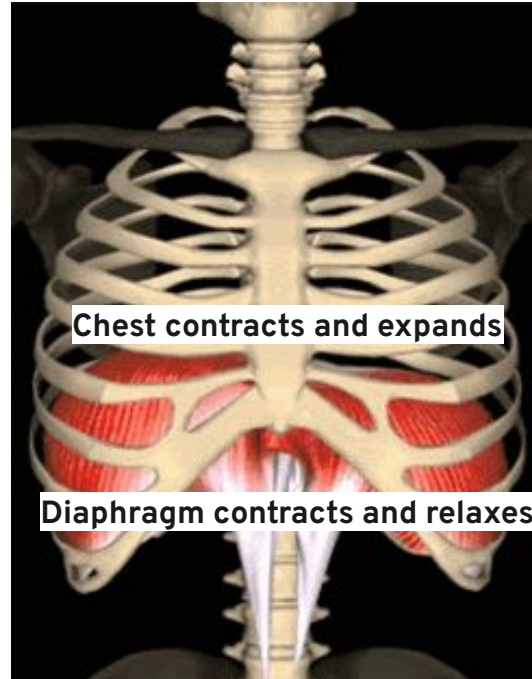
Voice Synthesis

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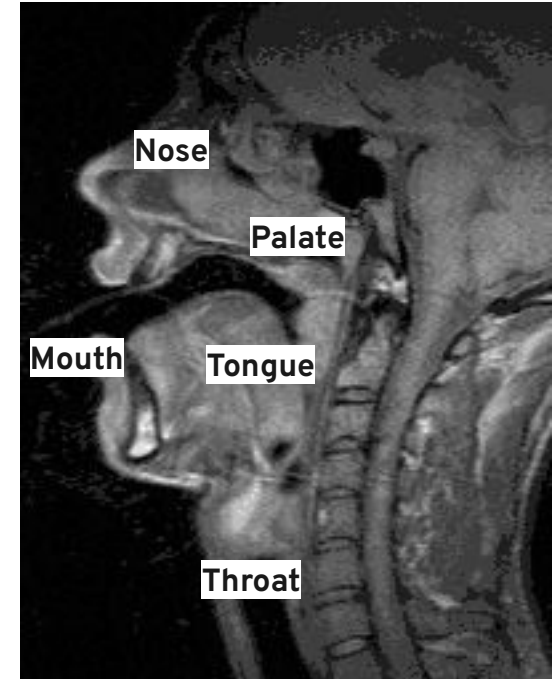
2. Power Source



Chest contracts and expands

Diaphragm contracts and relaxes

3. Speech Production



Nose

Palate

Mouth

Tongue

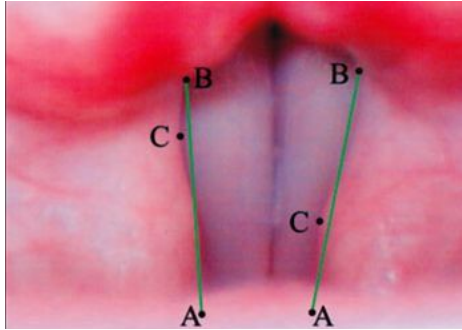
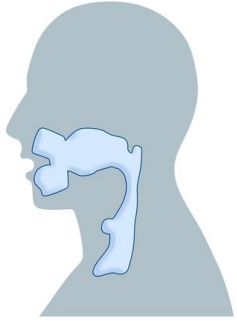
Throat

Properties of the Voice

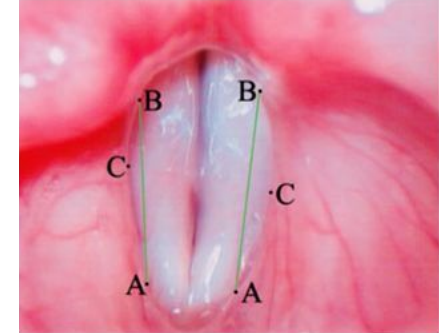
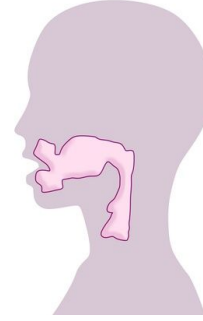


- Voice is a complex interplay of **anatomy**, **identity**, **environment**, and **sociocultural** factors
- Key characteristics
 - **Pitch**
 - **Resonance**
 - Intensity
 - Vibrato
 - Timbre
 - Duration
 - Prosody
 - Tempo
 - Breathiness
 - Articulation
 - Hoarseness

Masculine and Feminine Voices



Laryngoscopy of MALE larynx

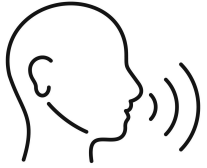


Laryngoscopy of FEMALE larynx

Testosterone exposure causes **growth** to vocal folds and vocal tract

- Average male vocal folds roughly 25% longer and 20% thicker than average female vocal folds
- During pubertal exposure to testosterone, these anatomic changes lead to a lower pitched voice (lower fundamental frequency F0)

Current Treatments



Voice Therapy (i.e. Transgender Voice Training)

- Meet with speech-language pathologist or otolaryngologist
- Develop skills in pitch modification, vocal hygiene, articulation, resonance, prosody, word choice, pragmatics, and nonverbal communication

Hormone Therapy

- Testosterone hormone to thicken vocal cords and deepen voice

Non-Invasive

Current Treatments



Phonosurgery

- Surgical techniques: cricothyroid approximation, cold knife shortening glottoplasty, laser shortening glottoplasty, laser reduction glottoplasty, thyroplasty
- Potential complications:
 - Negative effects on swallowing and/or breathing
 - Sore throat
 - Infections
 - Scarring
 - No change in pitch or a less than desired increase in pitch
 - Reduced loudness
 - Decreased vocal range
 - Decreased clarity
 - Pitch instability
 - Irregularity of voice

Invasive

Clinical Outcomes

- No randomized clinical trials and prospective cohort studies that study phonosurgery are available
- Evidence is not conclusive regarding which surgical technique is better for vocal treatment in transgender individuals
- Research suggests F0 can be increased after speech therapy in transgender women

Transfemales in the U.S.

341,800 (25.6%)

Transfemales in the identified
transgender population in the U.S.

48%

of transfemales want voice therapy

14%

of transfemales have undergone voice therapy

1%

of transfemales have undergone phonosurgery

1. Winter, Sam, et al. "Transgender people: health at the margins of society." *The Lancet* 388.10042 (2016): 390-400.
2. James, S. E., et al. "The report of the 2015 US Transgender Survey <https://transequality.org/sites/default/files/docs/usts/USTS-Full-Report-Dec17.pdf>" Accessed June 3 (2016): 2019.

Introducing AlloVoz



AlloVoz is an AI-based platform that guides independent voice modification for transgender patients with voice dysphoria

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Value Proposition








Comprehensive

Private/Safe

Customizable

Affordable

Stakeholder Interviews

	Speech Pathologist	Speech Pathologist	Policy Analyst	Speech Pathologist	Entrepreneur	HCI Researcher	Trans Community
Organization	 Massachusetts Eye and Ear		 <small>AMERICAN SPEECH-LANGUAGE- HEARING ASSOCIATION</small>	 <small>SCHOOL OF COMMUNICATION</small>	 <small>MODULATE</small>		
Stakeholder	Abby Garneau	Nicole Gress CEO/Founder, Undead Voice	Meghan Ryan	Sarah Penzell Assistant Clinical Professor	Mike Pappas CEO/Co-founder	Alex A. Ahmed HCI Researcher and Designer	"Ana" "Sara"

Stakeholder Insights

“Therapy starts with identifying patient goals – similar to showing a photo to a hairdresser.”

- Transgender speech pathologist

“Therapy is not a cookie cutter process.”

- Transgender speech pathologist

“Current voice apps are not good at all – they simply don’t cut it.”

- Transfemale with voice dysphoria

Key Findings

Significant distrust of health system

Lack of access to therapists and insurance

Limited scope of mobile speech therapy apps

Apprehension and fear of using voice in public

Frustration from not achieving desired voice

“I think about my voice every minute of every day.”

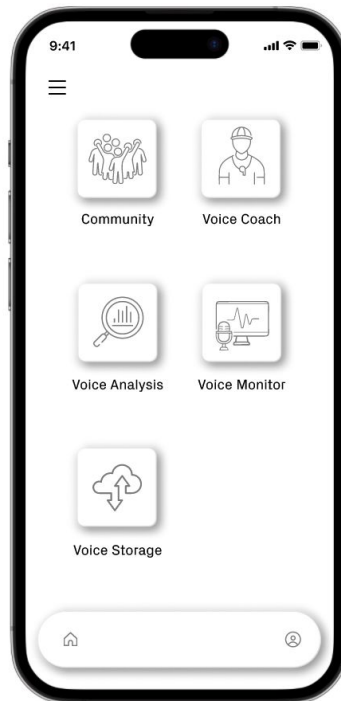
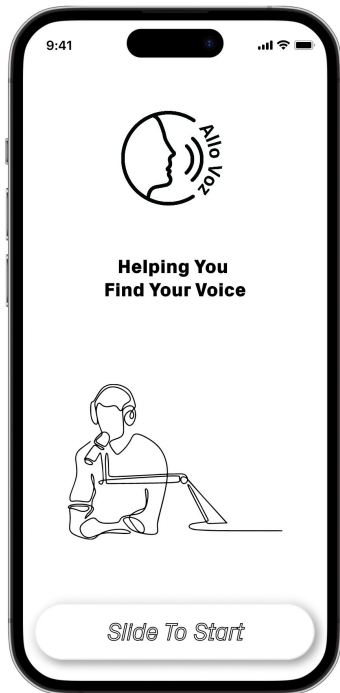
- Transfemale with voice dysphoria

Register

Simulate Target Voice

Choose Your Practice

Self-Affirmation



Voice Analysis

Voice Monitor

Voice Connect

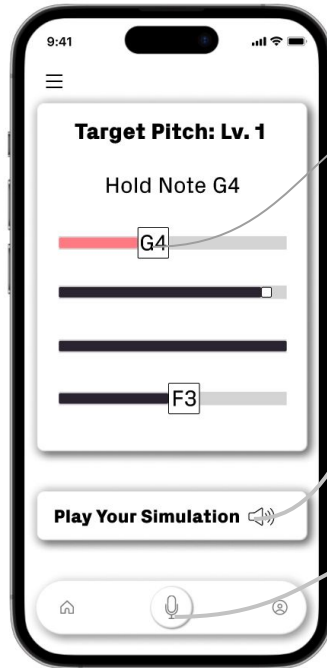
Voice Storage

2024

2025

2026

2027



2. Pitch/Resonance Adjustment

- Generative Exercises

3. Simulate User's Target Voice

- AI-based model

1. Press to Speak



Register

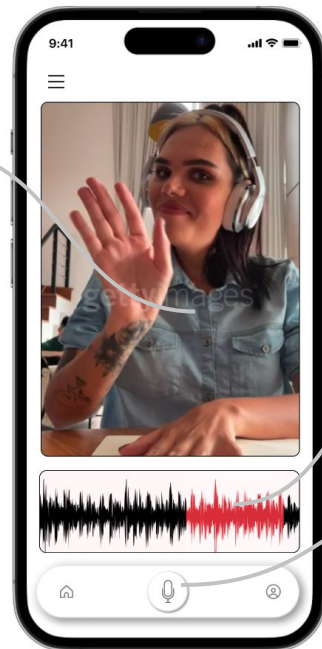
Simulate Target Voice

Choose Your Practice

Self-Affirmation

Community-based Interactions

Interact & practice with trans and nonbinary individuals, speech pathologists for guidance



Pitch/Resonance Detection

Real-time tracking of speech progress used to generate actionable feedbacks

Press to Talk

Giving users the ability to pause in case of discomforts

Voice Analysis

Voice Monitor

Voice Connect

Voice Storage

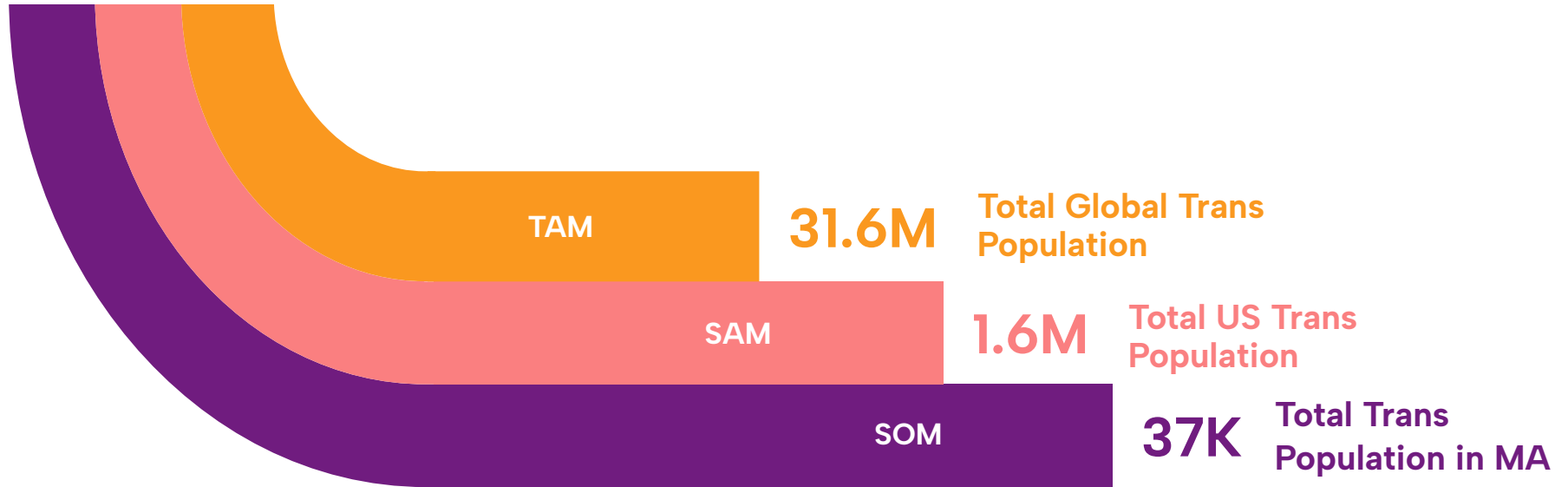
2024

2025

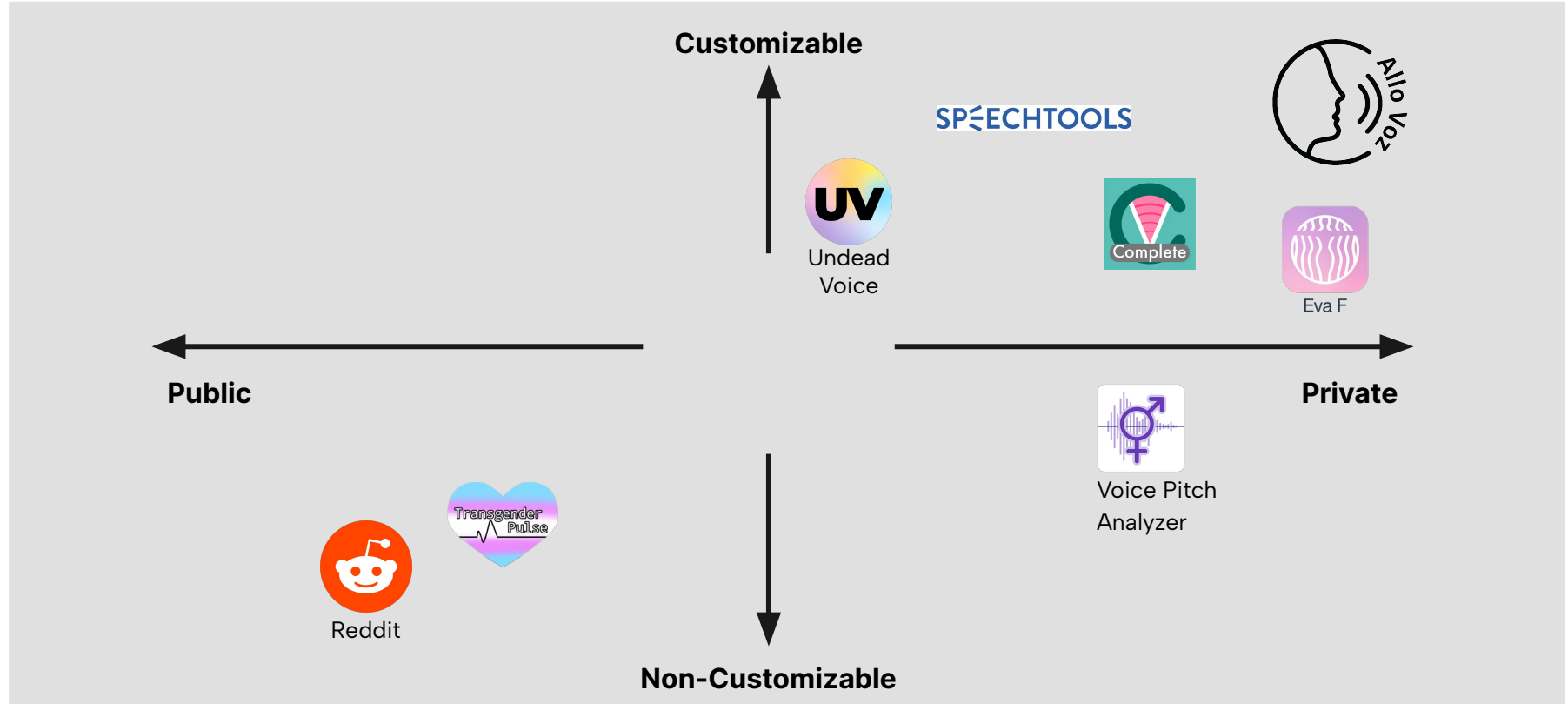
2026

2027


Market Analysis



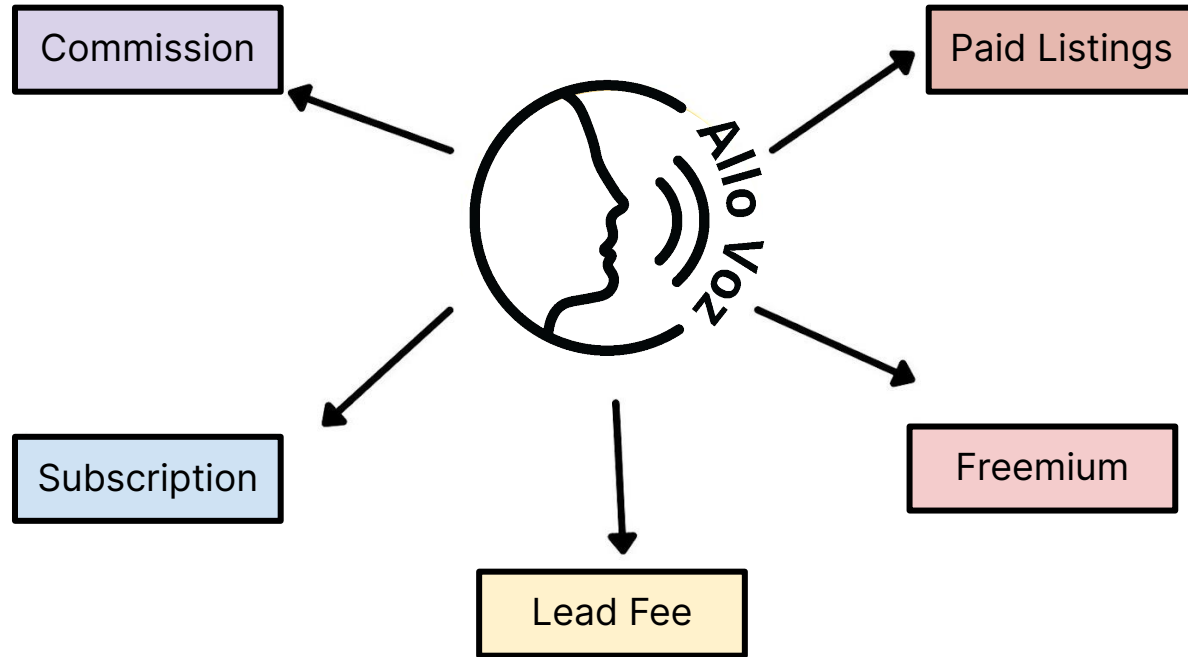
Competitive Landscape



Business Plan

2023	2024	2025	2026	2027
<p>AlloVoz </p> <p>Establish collaborations with experts on AI/ML-based voice analysis</p> <p>Develop app capabilities</p> <p>Beta testing within local trans community</p>	<p>V1 Launch and Capitalization</p> <p>Launch V1 on IOS and Android platforms</p> <p>Secure seed financing of \$5M</p>	<p>V2 Release</p> <p>Second iteration of app available.</p> <p>Paid subscription for more advanced users.</p> <p>Development of V3 as software for a medical device</p>	<p>Development and Testing</p> <p>Trial of mobile medical device and desktop software with HMS</p>	<p>V3 Release</p> <p>HIPAA-compliant</p> <p>New advanced features (e.g. communication with speech pathologists)</p>

App Revenue Streams





Helping Transgender Individuals
Find Their Voice

Regulation & Reimbursement

Federal and State Regulatory Environment

- FDA regulates sale of medical devices and monitors the safety of all regulated medical products
- Nationally: Medicaid expanded to cover all five gender affirming health services
- States determine or influence components insurance coverage, quality of care and provider infrastructures
- States can design and administer their Medicaid programs. Medicaid eligibility and benefits vary from state to state

Reimbursement

- States: 13 States reported they allow for voice therapy services but require prior authorization
- 38 states do not cover voice dysphoria or have not addressed in state policy
- Only 2 States cover all five gender affirming health services: Maine and Illinois
- Insurance often does not cover voice therapy if the only goal is to improve or change voice quality without a medical diagnosis
- 97% of patients pay for out-of-pocket medical medical equipment
- Out of 1.4 M trans adults only 152,000 had Medicaid coverage