LEADING MEDICINE: A TOWN HALL CONVERSATION WITH DR. MARC BOOM

Town Hall Conversation XXIX
Taking Stroke Care to the Next Level:

Patient-Centered Neurological Care
Today's Agenda

Discuss current challenges in stroke care
How should we meet this challenge?
How has virtual care changed our field?
The Baseline State:

A 58-year-old woman comes to the ER with dizziness and blurry vision.
Stroke Triage in 2022
Triage

RN intake
CT scan
ER provider: go or no-go stroke call
Stroke team evaluation
The Problem

**Very human dependent**
- How experienced and effective is the triage nurse?
- How busy are the providers?
- How experienced and effective is the radiologist?

**Very environment dependent**
- How crowded is the ER?
- How good are the resources at the facility?

**Very patient dependent**
- Risk factors?
- Able to tell their story?
- Did they come too late?
The Solution

Provide the highest-level expertise first
Triage

• ER provider: *go or no-go stroke call*
  • Tendency to over-call ~30% of cases “just in case”
  • Unfortunately misses ~20% of subtle cases
  • Meaning Roughly half of all calls are wrong

Stroke team evaluation
But resources are limited so we need...

An infinitely intelligent, Inexpensive, Never tired, Always ready assistant who is a Good listener And even better observer.

We need a...
Stroke “Alexa”
Stroke App
Development of a Stroke App

- Always available, personal digital assistant who can answer one question:
Development of a Stroke App

• Always available, personal digital assistant who can answer one question:

Is this patient having a stroke?
Development of a Stroke App

Data Rich Inputs:
- Face
- Speech
- Imaging

Output:
Is this patient having a stroke?
SORT Study

- Used an iPhone X
  - Records patient facial movements describing a picture
  - Voice during spontaneous speech and after a prompt
- Only additional inputs are the ABCs:
  - Age, blood pressure, “chief complaint”
- Total time for interaction less than 5 mins and designed to seamlessly integrate into EMS or RN initial triage
Development of a Stroke App
Tell me what is going on?
Eye tracking

“Look to the left then to the right”
58-year-old woman with dizziness and blurry vision
58-year-old woman with dizziness and blurry vision
“Show me your teeth”
Calculate “micro-expressions”

- Ratio = $\frac{\text{Height}}{\text{Width}}$

If the ratio is greater than 0.20, we think the patient’s mouth is open wide enough.
Measure the contour of mouth, which is more accurate.

Opening Ratio = 0.27
Teeth Area Percentage(White/black) = 56%
The key ingredient in the process is the connection we have to patients.
This allows us to create a high-quality data library.
Our current library has over 6 years of high-quality stroke patient data, over 300 videos of acute stroke patients, over 700 normal subjects, and more than 7000 acute stroke brain scans.
Google or Amazon cannot easily access patient data or front-line triage video/audio of actual patients to learn from, but we can use their tools with our library of normal/abnormal to create this tool.
Why now?

COVID has fundamentally changed the doctor-patient relationship.

Patients want to avoid unnecessary ER evaluations, but they do not want to delay treatment when it is critical.

We need tools like a Stroke App for wherever a patient needs care.
The pipeline from pilot trial to pivotal study
Tool Development

Our pilot study of 94 patients, using facial recognition alone versus the ER doctor.

Machine gets: ~30s video only

ER MD gets: patient, family, CT scan, labs, vitals, chart full of information, med school, residency, experience, etc., etc.

How close do you think our process came to detecting stroke?
Tool Performance

Our First Prototype of Stroke App with video only proved:

93%
sensitive for detection of stroke
“Hot off the press”

Our First Prototype of Stroke App with video only proved equal in all patients:

93%

Toward Rapid Stroke Diagnosis with Multimodal Deep Learning

Mingli Yu¹, Tongan Cai¹*, Xiaolei Huang¹, Kelvin Wong², John Volpi³, James Z. Wang¹, Stephen T.C. Wong²

¹ The Pennsylvania State University, University Park, USA
² TT and WF Chao Center for BRAIN & Houston Methodist Cancer Center, Houston Methodist Hospital, Houston, Texas, USA
³ Eddy Scurlock Comprehensive Stroke Center, Department of Neurology, Houston Methodist Hospital, Houston, Texas, USA
A 58-year-old woman comes to the ER with dizziness and blurry vision.

The Future State:

- **Yes:** rapid treatment with clot buster and consider transfer to a high-level stroke center
- **No:** avoid risks and costs of a clot buster and save capacity in the high-level stroke center

*Safer, more efficient, higher quality care*
Our group has accomplished:

- Best in class CT processing that achieves “MRI like” stroke detection to replace the “stroke clock”
- A library of over 300 acute stroke patient videos
- A successful pilot study of facial recognition for stroke detection with high fidelity
- Presentations and publications of our data in national and international forums

A model for integrating augmented intelligence into a typical stroke workflow
Future work

A bright future for *augmented intelligence* in healthcare and at Houston Methodist as a Center of Excellence:

- World class data science and imaging expertise
- Diverse patients
- 20+ years of leadership in stroke trials
- Extensive and detailed database
- Integrity in data stewardship
- Active clinicians at the largest stroke center in the region

*A platform technology* with applications in Parkinson’s, Alzheimer’s, depression, epilepsy, and many more.
Future work

Delivering rapid, unparalleled expertise to the patient, regardless of distance or time.

Integrate with telestroke and advances in virtual care.
Acute TeleStroke

Rajan Gadhia, MD

October 21, 2022
Stroke Basics

- Stroke is the fifth leading cause of death in the United States. More than 140,000 people die each year from stroke in the United States.
- Stroke is the leading cause of serious, long-term disability in the United States.
- About 795,000 people have a stroke in the United States each year.
- Strokes can and do occur at ANY age. Nearly one fourth of strokes occur in people under the age of 65.
Ischemic Stroke

- In the United States, majority (~87%) of strokes occur in the setting of lack of blood flow to a part of the brain.
- Etiologies of which vary, but could be thrombotic, embolic, hemodynamic, or a combination.
- HTN remains the leading modifiable risk factor for stroke.
- Encompasses acute ischemic infarcts as well as transient ischemic attacks.
Ischemic Stroke

An ischemic stroke occurs when a clot or a mass blocks a blood vessel, cutting off blood flow to a part of the brain.
• 58-year-old woman (Jane Doe) brought to ED after being found altered and unsteady in a parking lot.
Timeline of Acute Stroke Therapy Trials

**September 2008**
- ECASS III Study shows benefit of IV tPA 3-4.5 hours from LKN

**January 2015**
- MRCLEAN Study shows added benefit of Endovascular thrombectomy within 6 hours of LKN from IV tPA vs. tPA alone

**2015/2016**
- ESCAPE, EXTEND-IA, SWIFTPRIME, REVASCAT studies confirm added benefit of Endovascular thrombectomy within 6 hours of LKN

**November 2017**
- DAWN Study shows added benefit of Endovascular thrombectomy 6 to 24 hours of LKN based on clinical-radiological mismatch

**January 2018**
- DEFUSE3 Study shows added benefit of Endovascular thrombectomy 6 to 16 hours of LKN based on perfusion-based radiological mismatch and AHA/ASA Stroke Guidelines UPDATED with Level 1a INDICATION as Standard of Care

**May 2018**
- WAKE UP Study shows benefit of IV tPA based on MRI DWI FLAIR mismatch >4.5 hours from LKN

**May 2019**
- EXTEND Study shows benefit of IV tPA based on perfusion mismatch up to 9 hours from LKN
Modified Rankin Scale (MRS)

0  No symptoms
1  No significant disability, despite symptoms; able to perform all usual duties and activities
2  Slight disability; unable to perform all previous activities but able to look after own affairs without assistance
3  Moderate disability; requires some help, but able to walk without assistance
4  Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5  Severe disability; bedridden, incontinent, and requires constant nursing care and attention
6  Death
Timeline of Acute Stroke Therapy Trials

December 1995 – September 2008

January 2015 – November 2017

May 2018 – May 2019
Evolution of Systems of Stroke Care
TeleStroke Implementation

TeleStroke Process Diagram: ED & IP

1. EMS/Air Medical brought patient to ED for evaluation with ED MD & triage.
2. EMS/Air Medical identify patient w/ potential acute stroke.
3. Patient presented via vehicle w/ acute stroke symptoms.
4. Inpatient/ICU patient identified by IP RN for potential acute stroke.
5. IP RN calls Rapid Response Team or intensivist.
6. ED MD/ IP MD assess Patient w/ NIHSS, LKN, & TPA contraindications.
7. ED RN/IP RN assess Patient w/ NIHSS, LKN, & TPA contraindications.
8. ED MD/ IP MD IP RN send Official TeleNeuro Alert & Request for Consult or downgrade sent via PerfectServe.
9. Patient is taken to STAT CT/CTA head and neck.
10. In-House Neurologist manages patient. TeleNeuro MD available for patient changes after hours (4:00pm-7:00am).

TeleNeuro MD conducts evaluation w/ observing NIHSS by ED RN/IP RN and consents patient for TPA, if applicable.

ED MD/IP MD/IP NP receives CT/CTA results and joins TeleNeuro MD & ED RN/IP RN in virtual patient room for video evaluation. Recommend face to face encounter between IP NP and patient or (if unable) Plan of Care communication between TeleNeuro MD and ED MD/IP MD/IP NP.

TeleNeuro MD makes determination for TPA/thrombectomy after review of CT/CTA exam, LKN, and contraindications and documents in EPIC.

Does patient need TPA and Thrombectomy?

Yes

Does TeleNeuro MD want to utilize a virtual consult?

No

No

ED MD/IP MD/IP NP orders and administers TPA and ED RN/IP RN monitors neurological exam and VS.

ED MD/IP MD/IP NP orders and administers TPA and ED RN/IP RN monitors neurological exam and VS.

In-House Neurologist manages patient. TeleNeuro MD available for patient changes after hours (4:00pm-7:00am).

All sites except HMWT, HMWB and HMSL: TeleNeuro MD recommends that ED MD/IP MD calls Transfer Center 713-441-4848 for transfer to HMH thrombectomy center/acute stroke. TeleNeuro MD contacts HMH Neuro Team about Transfer. Only HMWT, HMWB and HMSL: TeleNeuro MD discusses with NeuroMD On Call.
Technology and...
TeleStroke Video Evaluation
Tele-Neurology: Go-Live Timeline

6/26/2017
CSC: Houston Methodist
The Woodlands

11/27/2017
PSC: Houston Methodist
Willowbrook

9/17/2018
PSC: Houston Methodist
West Houston

10/3/2019
PSC: Houston Methodist
Sugar Land

3/10/2020
PSC: Houston Methodist
Sugar Land

3/16/2020
PSC: Houston Methodist
Baytown

Tele-Neurology: Consults & Coverage

Tele-Stroke Consults & Patients

6,557 Consultations
June 2017 – YTD

3,815 Consultations
Jan 2021 – YTD

423 Patients
Transferred to a Comprehensive Stroke Center
June 2017 – YTD

Tele-Stroke Coverage

7 Board Certified Physicians
Monday – Friday:
7am – 4pm (daytime)
4pm to 7 am (after hours)

Saturday, Sunday, & HM Holidays:
24 hour coverage

6 ECC Locations: Sienna, Cinco Ranch, Cypress, Spring, The Woodlands, Deer Park (Added Dec 2020)
Acute and Tele-Neurology
Go-Live & Growth Timelines

**Tele-Neurology: Go-Live Timeline**

- **6/26/2017**: CSC: Houston Methodist The Woodlands
- **11/27/2017**: PSC: Houston Methodist Willowbrook
- **9/17/2018**: PSC: Houston Methodist West Houston
- **10/3/2019**: PSC: Houston Methodist Sugar Land
- **3/10/2020**: PSC: Houston Methodist Baytown
- **3/16/2020**: PSC: Houston Methodist Clear Lake

**Tele-Neurology: Growth Timeline**

- **April 2018**: 100 Consults
- **March 2019**: 500 Consults
- **August 2019**: 1000 Consults
- **October 2019**: Two 24/7 sites joined (HMB & HMCL)
- **March 2020**: 2000 Consults
- **July 2020**: Deer Park ECC joined
- **Dec 2020**: 3000 Consults
- **Feb 2021**: End User Survey
- **March 22, 2021**: Results came in
- **March 2021**: Hemorrhage process shared and approved by NS
- **May 2021**: End User Survey Distributed
- **June 2021**: 6,557 consults

**End User Survey Distributed**

- **Distributed March 2-23, 2021**
- **March 26, 2021**
- **June 2021 (October 2022)**

**1st ELVO Task Force meeting**

- **Jun 2017**
- **Mar 2018**
- **Apr 2018**
- **Jan 2019**
- **March 2019**
- **Aug 2019**
- **Oct 2019**
- **Mar 2020**
- **June 2020**
- **Aug 2020**
- **Dec 2020**
- **Feb 2021**
- **March 2021**
- **June 2021**
- **TODAY** (October 2022)

**ELVO Task Force transitioned to Acute Stroke Task Force**

- **March 2018**
- **April 2018**
- **March 2019**
- **August 2019**
- **July 2020**
- **March 2021**
- **June 2021**
- **TODAY** (October 2022)

**System Acute Task Force**

- **May 2021**
- **June 2021**
- **TODAY** (October 2022)

**Hemorrhage workflow process**

- **March 2021**
- **May 2021**
- **June 2021**
- **TODAY** (October 2022)
Table 1: Time to thrombolytic therapy at HMH in 2020

Door to Needle (DTN)

<table>
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<th>Avg (Min.)</th>
<th>Median (Min.)</th>
<th># of Patients</th>
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<td>50.9</td>
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<tr>
<td>February</td>
<td>42.3</td>
<td>43.5</td>
<td>n = 14</td>
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<tr>
<td>March*</td>
<td>63.0</td>
<td>67.5</td>
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<tr>
<td>April**</td>
<td>57.6</td>
<td>45.0</td>
<td>n = 7</td>
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*First suspected cases of COVID in Houston, TX USA
**Implementation of a telestroke-based evaluation for all suspected acute strokes.

55% DTN increase with COVID (Median – Feb to Mar Month over Month)
33% DTN decrease with implementation of Tele-neurology (Median – Mar to Apr Month over Month)
Case

- 58-year-old woman (Jane Doe) brought to ED after being found altered and unsteady in a parking lot.

- ED triage team evaluates patient, and immediately suspects an acute neurological emergency, and acute TeleStroke team is activated as patient is transported to the CT scanner.
Acute Evaluation
Beyond Clinical Care – Research
Music Therapy in Stroke Care

Maegan Morrow, Senior Music Therapist

October 20, 2022
Center for Performing Arts Medicine Mission

**to effectively translate the collaborative potential of arts and medicine to the holistic healthcare environment of Houston Methodist**

- Specialized health care and education for performing artists,
- Effective and meaningful integration of the performing and visual arts into the hospital environment,
- Creative Arts Therapy that utilizes the arts in support of patient goals, and
- Research that harnesses the broadest potential of the arts in therapy, rehabilitation and human performance.
Creative Arts Therapies

HMH (music and art therapy)
- Acute Psychiatry
- Outpatient Behavioral Health
- Inpatient Rehabilitation
- Outpatient Oncology
- BMT
- CVICU
- SLICU
- Palliative Care

HMB (music therapy)
- ICU (open position)

HMSL (music therapy)
- Cancer Infusion Center

HMWB (music therapy)
- Neonatal ICU

HMW
- ICU (open position)

HMTW (music therapy)
- Comprehensive Stroke Team
Music Therapy Credential

Music Therapy Degree
(Undergrad/Equivalency/Graduate from AMTA approved program)

1200 Clinical Fieldwork Hours
(from approved AMTA site)

Board Certification Exam

MT-BC Credential
Music therapy is the clinical & evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an accredited music therapy program. (AMTA)

- Not about teaching/developing musical skills
- Concept of change
- Social and humanistic psychological roots
- Functional change
  - Communication, cognition, physical, social, emotional and neurological functioning
- All ages, groups, individuals
Medical Goals/Interventions

**Goals:**
- Reduce anxiety/depression associated with medical trauma
- Promote reality orientation during ICU delirium
- Promote emotional processing of medical trauma
- Enhance respiratory strengthening in preparation for vent weaning
- Promote opportunities for family bonding through end-of-life legacy work

**Interventions:** songwriting, salient live music for orientation/grounding, music-assisted guided imagery, OMREX (oral motor and respiratory strengthening exercises) with harmonica, rhythmic diaphragmatic breathing, and heartbeat recordings.
The Power of Music

• Is there a biological basis for the experiences that people talk about?
  – Heart rate increases, breathing deepens, their muscle tension increases
  – Human body falls into synchronism with a rhythmic phenomenon
  – Hormones and neurochemicals
    • Adrenaline, cortisol and ACTH
    • Prolactin, oxytocin, dopamine
The Power of Music

• Specific parts of the brain are involved in perceiving different musical elements
  – Pitch, harmony, melody, dynamics, rhythm
  – e.g., specific neurons in the auditory cortex are tuned to perceive specific pitches

• Some of the areas involved: auditory cortex, motor cortex, prefrontal cortex, sensory cortex, the visual cortex, nucleus accumbens, and amygdala, hippocampus and so on
Music Listening

- **Hearing music**
  - Auditory cortex
    - Core: pitch and volume
    - Surrounding: timbre, melody and rhythm

- **Imagining Music**
  - Auditory cortex to a lesser magnitude
  - Inferior frontal gyrus (retrieving memory)
  - Dorsolateral frontal cortex (working memory)
Music Engagement

- Playing music
  - Auditory cortex (feedback system)
  - Visual cortex (reading a score)
  - Parietal lobe (e.g., computation of finger position)
  - Motor cortex
  - Sensory cortex
  - Frontal lobe
  - Cerebellum
Music as a Reward

- Emotional reaction to music
  - Reward structures such as ventral tegmental area (when you get chills!)
  - Same areas that get activated while
    - Eating
    - Sex
    - Using drugs
  - Pleasing song → inhibition of amygdala
Paradigm Shift  
From MT to NMT

• Traditionally, music in therapy has been based on a model that uses music to facilitate concepts of well-being.

• Neuroscience research with the help of neuro-imaging has shifted the model to a perceptual model.

• They are based on how music perception and production engage the brain in ways translated to non-musical therapeutic learning and training.
Neuroplasticity

• The essence of recovery

The brain’s ability to reorganize itself by forming new neural connections throughout life.

Neuroplasticity allows the neurons (nerve cells) in the brain to compensate for injury and disease and to adjust their activities in response to new situations or to changes in their environment.
Auditory Cortex
Researchers demonstrated a relationship between neural processing of auditory stimuli and the arousal of the motor system, resulting in an entrainment effect.
Neurologic Music Therapy

is the therapeutic application of music to cognitive, sensory and motor dysfunction due to neurologic disease of the human nervous system.

is based on a neuroscience model of music perception and production, and the influence of music on functional changes in the non-musical brain.
Shared Rehabilitation Goals

- **Memory**: Echoic, Working, Long-term
- **Attention**: Sustained, Selective, Alternating, Divided
- **Motor Control**: Balance, ROM, Walking, Endurance
- **Emotions**: Affective Expression, Reality Orientation, Mood Control, Cognitive Coherence, Psychosocial Functions
- **Perception**: Auditory, Sensory Integration
- **Executive Function**: Organization, Planning, Decision Making, Inhibition
- **Language**: Expressive and Receptive Language, Articulation, Speech Development, Vocal Quality

Music
Rhythm and the Brain

RHYTHM IS PROCESSED SUBCORTICALLY

THE BRAIN PROCESSES THE SPACE BETWEEN THE BEATS

RHYTHM ASSISTS IN ANTICIPATION OF MOVEMENT AND FLUENCY OF MOVEMENT

RHYTHM ACTS AS A PRIMING MECHANISM TO THE MOTOR SYSTEM
NMT Techniques

• Sensorimotor Training

- Rhythmic Auditory Stimulation
- Patterned Sensory Enhancement
- Therapeutic Instrumental Music Performance
NMT Techniques
Speech and Language Training

• Melodic Intonation Therapy (MIT)
• Musical Speech Stimulation (MUSTIM)
• Rhythmic Speech Cuing (RSC)
• Vocal Intonation Therapy (VIT)
• Oral Motor and Respiratory Exercises (OMREX)
• Developmental Speech and Language Training through Music (DSLM)
• Therapeutic Singing (TS)
• Symbolic Communication through Music (SYCOM)
NMT Techniques
Cognitive Training

• Musical Sensory Orientation Training (MSOT)
• Musical Neglect Training (MNT)
• Auditory Perception Training (APT) – 2 subcategories
• Musical Attention Control Training (MACT) – 4 subcategories
• Musical Executive Function Training (MEFT)
• Musical Mnemonics Training (MMT)
• Associative Mood and Memory Training (AMMT)
• Music Psychotherapy and Counseling (MPC)
Rhythmic Auditory Stimulation

• Rhythm has physiological function to stimulate movement

  Applies auditory sounds to movement (walking, stepping) 2/2, 2/4

  Therapist gradually increases to form a pattern

  Rhythmic entrainment, priming of auditory motor pathway, cueing of movement
Music Therapy in Rehabilitation

Goal: Increase endurance during ambulation

Intervention: Rhythmic Auditory Stimulation (RAS)
RAS has been included in the official Canadian Stroke Best Practice Guidelines

Clinical Practice Guidelines for the Management of Stroke Rehabilitation of the U.S. Veterans Administration and the Department of Defense
Therapeutic Instrumental Performance

Utilizes musical instruments to help patients to exercise impaired motor function and regain functional patterns of movement
Melodic Intonation Therapy

- Utilizes a patient’s unimpaired ability to sing to facilitate speech production
- Focuses on functional sentences and brief statements that are translated in melody
- Melody is developed based on inflection patterns
- Later stages of treatment the singing is reduced to “speech singing” and finally retranslated to normal speech prosody
• Addressing the improvement of articulatory control, respiratory strength, and function of the speech apparatus

• Using instruments such as:
  – Harmonica
  – Kazoo
  – Recorder
• Promotes improved walking (gait) patterns
• Improves affected limb functions (arms, hands, etc.)
• Helps improve speech (aphasia, apraxia, dysarthria)
• Improves cognitive functioning (attention, memory)
• Alleviates post-stroke anxiety and depression
• Promotes “massed practice” for neuroplasticity
19 Current Procedural Terminology (CPT) codes that may be used for music therapy services.

Medicare, Medicaid, Private Insurance, and Third-Party Payer.

Most reimbursed services support children on the autism spectrum and those with developmental delays.

Does not always impede clients from benefiting from other therapeutic services.
The Harrison Center for Music Therapy
www.harrisoncentermt.com

Houston Aphasia Recovery Center HARC
www.harctx.org
Questions or Resources

mmmorrow@houstonmethodist.org

www.musictherapy.org
My Brain on Foo Fighters
Further Reading

• Sacks, Oliver, Musicophilia: Tales of Music and the Brain, 2007.
• Thaut, Michael H. and Gerald C. McIntosh, “How Music Helps to Heal the Injured Brain: Therapeutic use Crescendos Thanks to Advances in Brain Science,” Cerebrum, March 2010.
COVID-19 Viral Load Detected in City of Houston Wastewater

Viral Load: **39%**
In comparison to July 6, 2020

Positivity Rate: **7%**

COVID-19 Viral Load in Wastewater (Compared to July 6, 2020)

https://covidwwtp.spatialstudieslab.org/
Houston Methodist COVID-19 Cases By Day

Houston Methodist COVID-19 Patients by Day

Data as of October 16, 2022
IF CASES ARE DOWN IN MY COMMUNITY, WHY SHOULD I GET THE NEW BOOSTER?

THE VIRUS THAT CAUSES COVID-19 CHANGES OVER TIME. KEEP YOUR PROTECTION AGAINST COVID-19 UP TO DATE BY GETTING A BIVALENT COVID-19 VACCINE BOOSTER DOSE.
How do the updated vaccines differ from the original one?
How effective is the new booster against Omicron?
A Bivalent Omicron-Containing Booster Vaccine against Covid-19

Choulis S et al. DOI: 10.1056/NEJMoa2208343

C L I N I C A L  P R O B L E M

COVID-19 vaccines have had decreasing effectiveness against the omicron variant, with many breakthrough infections reported. Holding the ability to boost immune response in the face of omicron is important.

C L I N I C A L  T R I A L

Design: An ongoing, open-label, phase 2-3 trial examined the safety and immunogenicity of an omicron-specific booster vaccine in persons who were fully vaccinated against Covid-19.

Intervention: 810 participants who had received a two-dose primary series of the mRNA-1273 vaccine plus a booster dose at least 3 months earlier were given a second booster with either the bivalent mRNA-1273/2314 vaccine (containing 25 μg each of an ancestral Wuhan-Hu-1 and omicron B.1.1.529 spike mRNA) or the monovalent 50-μg mRNA-1273 booster containing Wuhan-Hu-1. The primary objectives were to assess the safety, reactogenicity, and immunogenicity of mRNA-1273/2314 at 28 days, as shown by a superior or noninferior neutralizing antibody response against omicron and non-omicron responses against ancestral SARS-CoV2 with the D614G mutation.

R E S U L T S

Immunogenicity: In participants without previous SARS-CoV2 infection, the bivalent booster prompted a superior neutralizing antibody response to omicron and was non-inferior to the monovalent booster in generating neutralizing antibodies against ancestral SARS-CoV2 (D614G). Higher neutralizing antibody responses against both omicron and ancestral SARS-CoV2 were also observed in participants with previous SARS-CoV2 infection who were given the bivalent booster.

Safety and Reactogenicity: Safety and reactogenicity were similar in the two groups.

L I M I T A T I O N S

• The trial was not randomized.
• Variant sequences were not ascertainment among those infected with Covid-19.
• Follow-up was short, so it is not known how long antibodies persist.
• The trial was not designed to evaluate vaccine effectiveness.

C O N C L U S I O N S

Among vaccinated persons who had received a booster against Covid-19, the bivalent omicron-containing mRNA-1273/2314 vaccine had a safety and reactogenicity profile similar to that of the monovalent mRNA-1273 booster vaccination and was superior in eliciting neutralizing antibody responses against the omicron variant.
Who is eligible for the Omicron booster right now?

How long should I wait if I recently received a booster dose?

Do I need to get an updated booster if I just had COVID-19?
COVID-19 VACCINE BOOSTER UPDATE

Everyone 5 years and older should get an updated booster
• If they have completed their primary series
• If it has been at least 2 months since their final primary dose or last booster

cdc.gov/coronavirus

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<td>Primary series</td>
<td>At least 2 months</td>
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<tr>
<td>Primary series + 1 booster</td>
<td>At least 2 months</td>
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<tr>
<td>Primary series + 2 booster</td>
<td>At least 2 months</td>
</tr>
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WHAT ABOUT MYOCARDITIS?
**GET THE FACTS**

**COVID-19, Myocarditis, and Vaccines**

Myocarditis is inflammation of the heart muscle. This can happen after viral infections like COVID-19 and, very rarely, after receiving mRNA COVID-19 vaccines.

Most people with myocarditis following vaccination recover completely with rest and simple treatment. However, myocarditis from COVID-19 can be very severe.

**If you’re UNVACCINATED:**

- **4x to 8x higher risk** of myocarditis from COVID-19 infection in all ages.
- **10x higher risk** of hospitalization from COVID-19 infection.

**If you received the COVID-19 vaccine:**

- **The overall risk of myocarditis is EXTREMELY LOW.**
  - 1 in 200,000

- **Young males (12-29 yrs) have a slightly higher risk, but still VERY LOW.**
  - 1 in 14,000

- **Less than 1 in 100,000**

**Don't miss your shot!**

Your heart is safer with COVID-19 vaccines!

For more information on vaccines, visit [COVID19LearningNetwork.org](https://www.idsociety.org/covid-19-real-time-learning-network/myocarditis-infographic/)
COVID-19 Bivalent Booster Dose Approved by FDA on August 31, 2022

NEW COVID-19 BOOSTERS FAQ

Q: Did the FDA and CDC approve this new booster?
A: Yes, they applied for EUA and were approved. Click here to see the fact sheet on the Pfizer bivalent vaccine booster, and click here to see the fact sheet on the Moderna bivalent vaccine booster.

Q: How do the new COVID-19 vaccine boosters differ from the existing vaccines and boosters?
A: These vaccines were specifically formulated to target the new COVID-19 variants. They are called bivalent because half of the COVID-19 vaccine targets the original COVID-19 virus, and the other half works against the Omicron variant, including the spike protein for BA.4 and BA.5 subvariants, which now account for nearly 100% of our positive COVID-19 cases.

Q: What are these new COVID-19 vaccine boosters made of?
A: According to Pfizer, the bivalent vaccine contains mRNA encoding the original SARS-CoV-2 spike protein, which is present in the original COVID-19 vaccine, together with mRNA encoding the spike protein of the Omicron BA.4/BA.5 variants. The booster stimulates the body’s immune system and works by causing the body to produce antibodies against the virus that causes COVID-19. Similar to the original COVID-19 vaccine, this vaccine uses mRNA that encodes instructions that cells in the body can use to make the spike protein, and these cells then make antibodies against the spike protein to help fight off the virus.

Q: Who is eligible for the new bivalent COVID-19 vaccine boosters?
A: The FDA granted EUA for the use of the Pfizer COVID-19 bivalent vaccine booster for individuals 12 years of age or older, while the Moderna COVID-19 bivalent vaccine booster received EUA for individuals 18 and older. The bivalent COVID-19 vaccine boosters are authorized as a single dose in people who have completed a primary vaccination series. People who have already received the initial two-shot series of either vaccine are eligible, as well as those who have received the original vaccine plus one or two booster shots.

Q: How long should I wait if I just received the existing COVID-19 vaccine booster?
A: According to the FDA, you should wait at least two months following the primary vaccine series or booster vaccination.

Q: How long will it take for new mRNA to develop after this shot?
A: Antibody levels will start to rise within days after getting the shot, but it will probably take a couple of weeks to get the highest amount of antibodies, according to Johns Hopkins School of Health.

Q: How long should I wait to get the bivalent booster if I just had COVID-19?
A: The FDA and CDC authorized the bivalent vaccine boosters for two months after previous booster or infection. Some experts say it may be beneficial to wait a little longer.

Q: Can I still get the original vaccine boosters?
A: No, the COVID-19 vaccine boosters that target only the original strain are no longer authorized as boosters in people 16 years old and older.

Q: How do I know these new COVID-19 vaccine boosters are safe since they were only tested on mice?
A: FDA officials say the public can rest assured that a great deal of care has been taken to ensure that these bivalent COVID-19 vaccine boosters meet the agency’s rigorous safety, effectiveness, and manufacturing quality standards for EUA.

According to the FDA, for each bivalent COVID-19 vaccine, the FDA based its decision on the totality of available evidence, including extensive safety and effectiveness data for each of the original COVID-19 vaccines in humans, safety and immunogenicity data obtained from a clinical study of a bivalent COVID-19 vaccine that contained mRNA specifically targeted to fight the omicron variant BA.1 variant in humans that is similar to each of the vaccines being authorized, and nonclinical data obtained using a bivalent COVID-19 vaccine that contained mRNA of the original strain and mRNA in common between the BA.4 and BA.5 lineages of the omicron variant. Human clinical trials of the bivalent vaccines targeting BA.4/BA.5 are ongoing.

Based on the data supporting each of these authorizations, the bivalent COVID-19 vaccines are expected to provide increased protection against the currently circulating omicron variant. Individuals who receive a bivalent COVID-19 vaccine may experience side effects commonly reported by individuals who receive authorized or approved monovalent mRNA COVID-19 vaccines, according to the FDA.

FDA officials explained in a press conference that they have extensive experience with strain changes for annual influenza vaccines, which also do not require clinical trials. They are very confident that they will increase immunization to the new variants and reduce the risk of serious outcomes and hospitalizations.

Q: Why haven’t these vaccine boosters been tested on humans?
A: The FDA studied mSpike data — and human clinical trial results from a similar vaccine that targets the original omicron strain (BA.1) and extensive research on mRNA technology — to evaluate the new shots in an effort to get them as soon as possible, according to recent briefings from the FDA commissioner, Dr. Robert Califf. Both companies are currently conducting human clinical trials on the new bivalent vaccine boosters targeting BA.4/BA.5.

Q: If I get the Pfizer COVID-19 vaccine booster, do I need the Pfizer bivalent shot or can I get Moderna?
A: No, according to the FDA, the updated booster you receive does not need to be from the same manufacturer that made the vaccine you received for your primary vaccination or previous booster.

Q: Why should I get the bivalent COVID-19 vaccine booster?
A: The BA.5 strain accounts for the vast majority of new COVID-19 cases in the U.S., according to the Centers for Disease Control and Prevention. These new vaccines are designed to significantly increase your immunity to the highly contagious strain and prevent severe disease. Experts are predicting another wave of COVID-19 in the fall and winter, and the bivalent vaccine boosters will help protect you against serious outcomes in the future. FDA officials also say staying up to date on COVID-19 vaccines and boosters will also help prevent long COVID symptoms if you contract COVID-19 in the future.
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Take care and be well