Multiplex Molecular Panels for Viral Diagnostic Testing Pros and Cons

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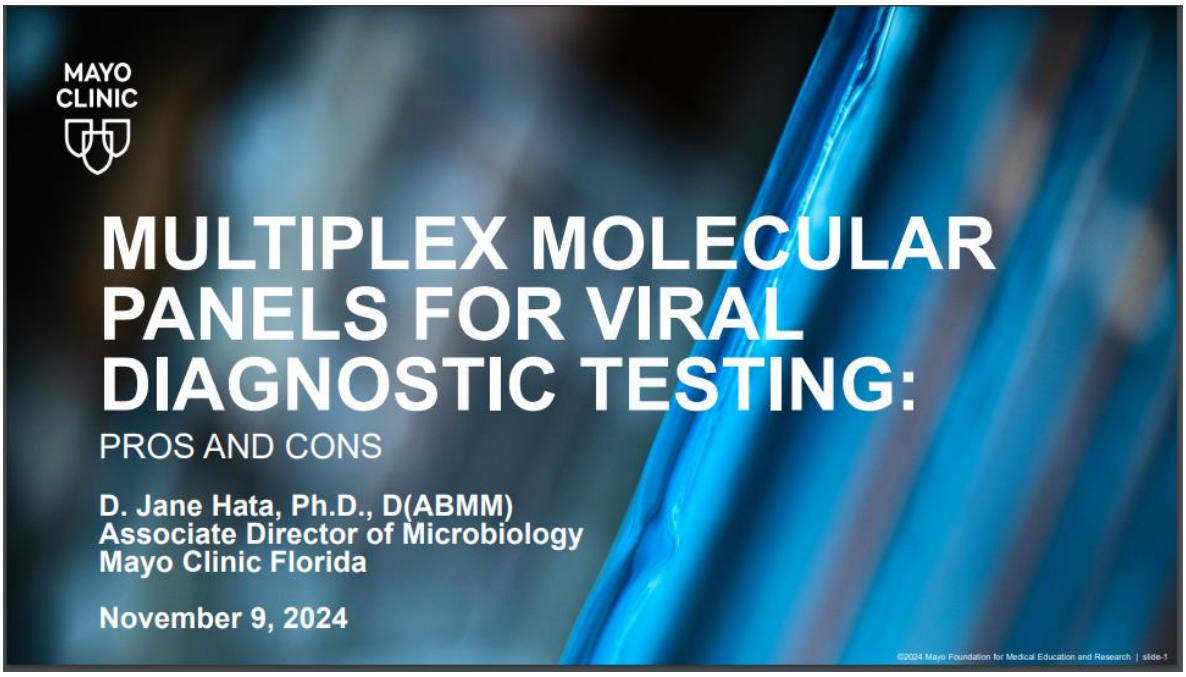
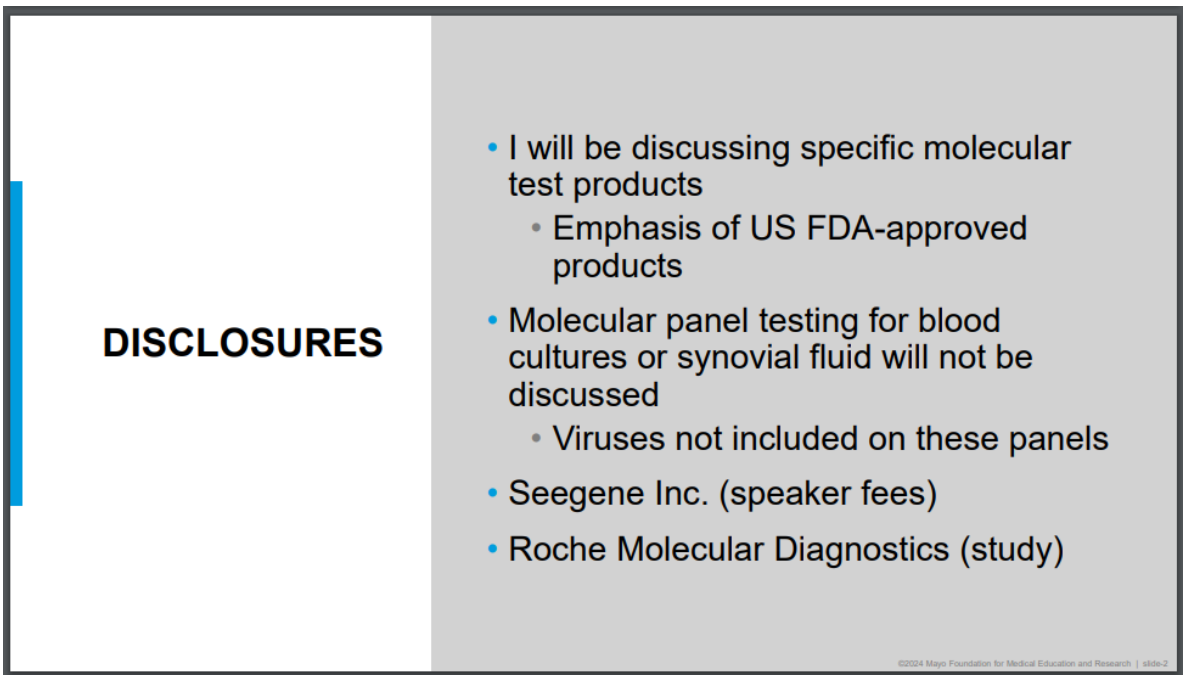
Memorias en presentación de PowerPoint.





LEARNING OBJECTIVES

- Understand the technologies utilized in molecular syndromic panel testing for viral pathogens
- Review the clinical significance of viral pathogens in respiratory, gastrointestinal and central nervous systems infections
- Understand the advantages and disadvantages of molecular panel testing for viral pathogens

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1 HOW DO MOLECULAR PANELS WORK?

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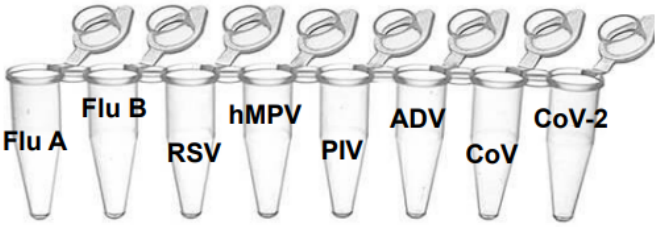
DEFINITIONS

- Multiplex Molecular Testing
  - Simultaneous detection and identification of multiple biomarkers (targets) in a single test
  - Sensitivity and specificity may be affected

- Syndromic Testing Panels
  - Multiplex testing based on body system or disease presentation
  - Multiple individual tests packaged in a single system
  - "Respiratory panel"
  - "Gastrointestinal panel"
  - "Meningitis/Encephalitis panel"



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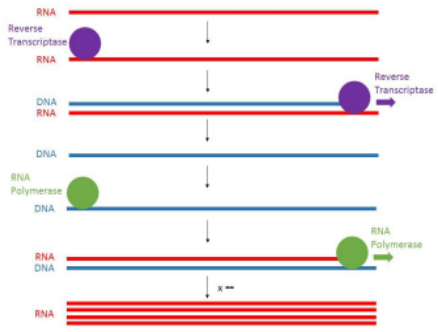
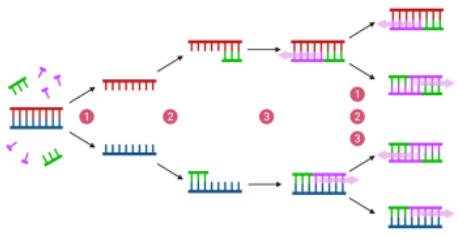
HOW DOES IT WORK?

- Goal is to provide multiplex molecular amplification in a single panel format
  - PCR based – DNA Amplification
  - Microarray based
  - Transcription-mediated amplification – RNA amplification
  - Ease of use by automation
- FDA-approved
  - Moderate to high-complexity testing
  - Specific sample types
  - Specific collection devices
  - Other than these parameters….classified as FDA modified or *laboratory developed tests*



https://en.wikipedia.org/wiki/Transcription-mediated_amplification



www.biorender.com/template/polymerase-chain-reaction-pcr

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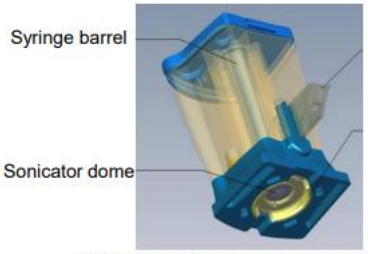
AMPLIFICATION METHODS

- Specimen is injected into panel strip/cartridge
- Chemical lysis to release nucleic acids from organism
- Cepheid
  - Multiplex PCR in a single cartridge
  - Smaller panel
- Biofire
  - Large-volume multiplex PCR
  - Single-plex nested PCR
  - Multiple reactions in a larger panel



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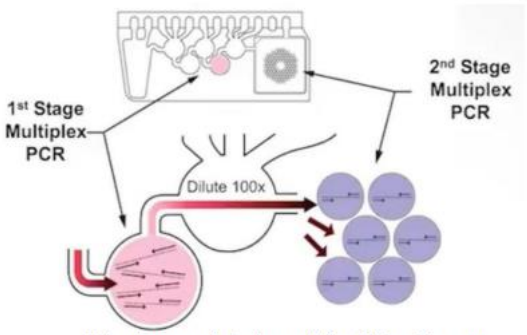

https://aseq.substack.com/p/the-biofire-filmarray

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A WIDE VARIETY OF PLATFORMS

- Panels vary in terms of available targets
- Large panels and small panels
- Sample to answer

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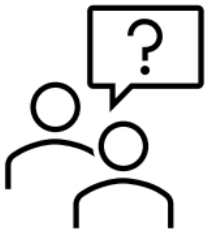
FALSE POSITIVE RESULTS

- Detection of residual nucleic acid
  - Prior infection
- Contamination of reagents with non-viable organism
- Contamination of sample during collection
- Contamination of sample during specimen processing
- Non-specific amplification exceeding baseline
- Error in laboratory resulting
- May result in unnecessary therapy or incorrect therapy
  - Antibiotics for viral infections



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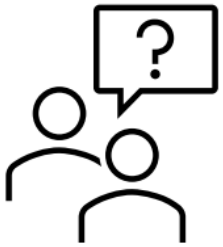
FALSE NEGATIVE RESULTS

- Insufficient amount of specimen
- Amplification inhibition
  - Enzymes, hemoglobin, poor extraction quality
- Amplification below the lower level of detection of assay
- Error in laboratory resulting
- May result in no therapy or exposures to pathogen



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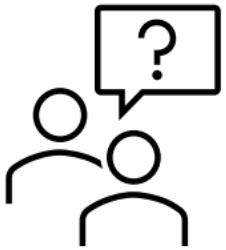
OTHER CONSIDERATIONS FOR PANEL IMPLEMENTATION

HIGH VOLUME PLATFORM VS. LOW VOLUME PLATFORM

- Patient population
  - Inpatient or outpatient?
  - High-risk patients?
    - Immunocompromised
  - Pediatric vs. adult?
  - US only – Will insurance cover the test?
- Specimen collection and stability - Logistics
  - Specific collection device
  - Transport to testing laboratory?
  - Transportation conditions (temperature)



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2 RESPIRATORY VIRAL PATHOGEN PANEL TESTING

SPECIAL REPORT

ADLM Guidance Document on Laboratory Diagnosis of Respiratory Viruses

Gregory J. Berry [a], Tulip A. Jhaveri [b], Paige M.K. Larkin,[c] Heba Mostafa,[d] and N. Esther Babady[e,*]

GJ Berry, et al. *Journal of Applied Lab. Med.*, Volume 9, Issue 3, May 2024, Pages 599–628.

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RESPIRATORY VIRUSES

- Influenza A
  - Subtypes H1, H3; H5
- Influenza B
- Human Metapneumovirus
  - Adults and children
- Respiratory syncytial virus (RSV)
  - Subtypes A, B
  - Pediatric and older adults
- Parainfluenza
  - Subtypes 1-4
  - Reinfection common
- Rhinovirus/Enterovirus
  - Most common in circulation
- Human Coronavirus
  - HKU-1
  - OC 43
  - NL 63
  - 229-E
  - SARS CoV-2 (COVID)
  - MERS – less common
- Adenovirus
  - URI's ,pharyngoconjunctival fever
- Bocavirus
  - Controversial status as pathogen
  - Persistence in LRT

Boncristiani HF et al,. Encyclopedia of Microbiology. 2009:500–18.

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MULTIPLEX RESPIRATORY PANELS

- Syndromic panels" for URI
- 3 – 22 targets: bacteria, viruses
- Nucleic acid amplification (NAAT) based,
  - 20 minutes - 4 hour run time
  - Specific instruments often required
  - All reagents contained in a cartridge or strip
  - Expensive
  - Random access or batch testing
  - Can detect "residual" nucleic acid
- Fast TAT can help target therapy
  - Influenza, CoV-2
- Pneumonia Panels for LRT
  - Atypical bacterial pathogens

Ramanan P, et al.2018. Clin Microbiol Rev 31.

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PERFORMANCE COMPARISON OF RESPIRATORY PANELS (N=210)

Viral Target	% Overall Agreement			Mean % Positive Predictive Agreement			Mean % Negative Predictive Agreement		
	FA	RPP	TAC	FA	RPP	TAC	FA	RPP	TAC
Adenovirus	96.2	97.6	98.1						
Influenza A	100	100	99.5						
Influenza B	100	100	100						
Parainfluenza (1 – 4)	98.6	99.0	98.1	95.8	91.6	93.4	96.9	99.1	99.3
HMPV	99.0	98.1	99.0						
Rhino/Entero	92.8	95.2	96.2						
CoV (not Co-V2)	97.1	97.1	99.0						
RSV	98.6	98.1	98.6						

FA: BioFire Respiratory Panel
RPP: Luminex XTag Respiratory Panel
TAC: Life Technologies TaqMan Array Card

Banerjee D,et al. J Clin Virol. 2022 Nov;156:105274.

ASSAY ISSUES THAT IMPACT TEST PERFORMANCE

- Changes in target sequence may reduce sensitivity
  - Influenza A Matrix gene mutations
  - Test developers must use “contemporary” isolates
    - SARS CoV-2 ”Alpha” variant
- Emergence of new agents with enhanced virulence
  - SARS CoV-2
- Reagent shortages secondary to epidemics/pandemics
  - SARS CoV-2
  - Influenza
- Quality of specimen collection
  - NP? Nasal? Throat?

Stellrecht KA.. J Clin Microbiol. 2018 Feb 22;56(3):e01531-17.

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DO IMPLEMENTATION OF RESPIRATORY PANELS AFFECT PATIENT CARE?

- Mixed results across multiple studies
  - Antibiotic Usage
    - Only difference noted in patients NOT receiving antibiotics before panel result
  - Length of hospital stay – No difference
- Diagnosis of influenza may lead to shorter hospital stay, fewer antibiotics, less diagnostic imaging
  - No impact when a non-influenza positive result was noted
- Clear guidance is needed!

Graf EH, Pancholi P.. Curr Infect Dis Rep. 2020 Feb 6;22(2):5.

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WHEN IS A RESPIRATORY PANEL APPROPRIATE?

- High pretest probability of respiratory viral infection
- When results will guide management:
  - Use of antivirals
  - Infection control measures
  - Outbreak surveillance
- Hospitalized patients
- Immunocompromised hosts
- Pediatric patients with severe disease or underlying conditions

GJ Berry, et al. *Journal of Applied Lab. Med.*, Volume 9, Issue 3, May 2024, Pages 599–628.

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WHEN IS A RESPIRATORY PANEL *NOT* APPROPRIATE?

- Testing of asymptomatic patients
  - "Screening" tests
- Testing in low-prevalence situations
  - False-positive results may occur
- Mild symptoms in otherwise healthy individuals (outpatient settings)
  - Consider small panels or targeted testing for Influenza or SARS CoV-2
- Assist providers with appropriate test selection to guide diagnostic stewardship

GJ Berry, et al. *Journal of Applied Lab. Med.*, Volume 9, Issue 3, May 2024, Pages 599–628.

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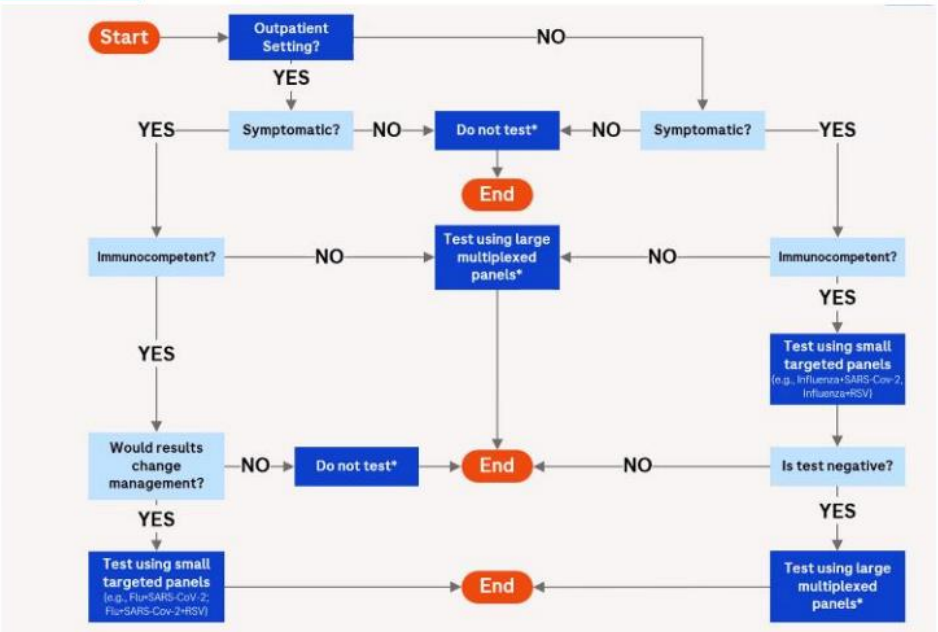
RESPIRATORY PANELS AND PATIENT MANAGEMENT



GJ Berry, et al. *Journal of Applied Lab. Med.*, Volume 9, Issue 3, May 2024, Pages 599–628.

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3 GASTROINTESTINAL (GI) VIRAL PATHOGEN PANEL TESTING

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GASTROINTESTINAL (GI) VIRAL PATHOGENS

- Rapid onset
  - Nausea, vomiting, non-bloody diarrhea, fever, malaise
- Self-limiting
  - 48 – 72 hours
- No antiviral treatment
  - Supportive care only
- Outbreaks associated with food, water, fecal-oral transmission, droplets, human gatherings
- Environmental persistence

Powell EA, et al. J Clin Virol. 2023 Dec;169:105612.

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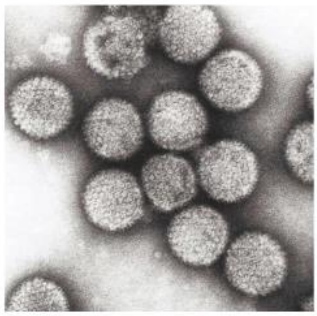
GI VIRUSES - DNA

- Adenovirus (*Adenoviridae)*
  - Over 100 subtypes, most of which result in GI disease
    - Types 40,41
  - 2% - 15% of pediatric diarrhea cases
  - 94% seroprevalence in adults (US)
  - Less association with large-scale outbreaks



Schnell, M et al. 2001. Jour Am Soc of Gene Therapy; 3: 708-22.

Powell EA, et al. J Clin Virol. 2023 Dec;169:105612.

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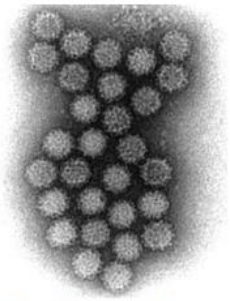
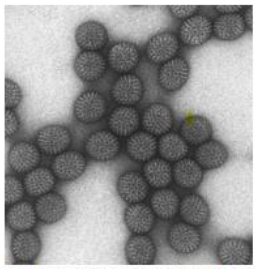
GI VIRUSES - RNA

- Norovirus (*Caliciviridae)*
  - 10 genogroups (GI – GX); GII.4 most common
  - High viral loads; $10^5 - 10^8$ copies/gram in stool
  - Greater significance in certain populations
    - HSCT, SOT – Severe disease and persistent viral shedding
- Rotavirus (*Reoviridae*)
  - Pediatric pathogen (< 5 y.o)
  - Seasonal epidemics January - June
  - Oral vaccine is available



https://step1.medbullets.com/microbiology/121540/norovirus



https://www.cdc.gov/rotavirus/about/photos.html

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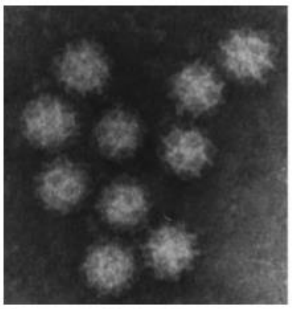
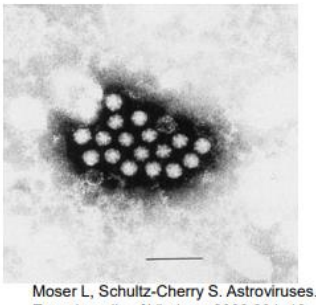
GI VIRUSES - RNA

- Sapovirus (*Caliciviridae)*
  - "Star of David" morphology
  - Less severe disease than norovirus
  - Fecal shedding of virus 1-4 weeks
  - May be emerging cause of GI disease in children < 5 y.o.
- Astrovirus (*Astroviridae)*
  - Star like morphology
  - Incidence peaks at 12-17 months of age; 2-9% of pediatric diarrhea cases
  - Resistant to inactivation

Powell EA, et al. J Clin Virol. 2023 Dec;169:105612.



Oka T, et al. Clinical Micro Rev. 2015 Jan;28(1):32-53.



Moser L, Schultz-Cherry S. Astroviruses. Encyclopedia of Virology. 2008:204–10.

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MULTIPLEX GI MOLECULAR PANELS

- "Syndromic panels"
- Up to 22 targets: bacteria, parasites, viruses included
- Nucleic acid amplification (NAAT) based,
  - < 4 hour run time
  - Specific instruments often required
  - All reagents contained in a cartridge or strip
  - Expensive
  - Random access or batch testing
  - Can detect "residual" nucleic acid
- Rafila et al study
  - 54.2% of pathogens detected with molecular method
  - 18.1% detected with conventional culture

Hata DJ et al. J Appl Lab Med. 2023 Nov 2;8(6):1148-1159
Rafila, A., et al. Clinical Microbiology and Infection, 2015; 21(8);719-728.

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PERFORMANCE COMPARISON OF GI PANELS

Viral Target	% Clinical Accuracy			% Analytical Sensitivity			% Analytical Specificity		
	FA	GPP	TAC	FA	GPP	TAC	FA	GPP	TAC
Adenovirus 40/41	97.7	94.7	95.3	97.4	57.9	68.4	97.7	100.0	99.2
Astrovirus	98.7	---	98.0	97.4	---	92.3	98.9	---	98.9
Norovirus	98.0	96.7	97.7	87.8	78.0	87.8	99.6	99.6	99.2
Rotavirus	96.3	99.3	98.3	100.0	95.8	89.6	95.6	100.0	100.0
Sapovirus	99.3	---	69.7	97.6	---	75.6	99.6	---	100.0

FA: BioFire Film Array
GPP: Luminex xTAG GI
TAC: Life TechnologiesTaqMan Array Card

Adapted from: Chhabra P, et al. J Clin Virol. 2017 Oct;95:66-71.

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ASSAY ISSUES THAT IMPACT TESTING

- False positives due to material contamination
  - BioFire GIP – Norovirus
- Lower sensitivity for some viruses
  - Adenovirus
- Only most common serotypes included on panels
  - Norovirus G II.4
  - Adenovirus types 40, 41

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WHEN IS A GI VIRAL PANEL APPROPRIATE?

- High-risk patient/severe disease
  - Immunosuppression?
  - Correlate use with clinical presentation of patient
- Rule out of bacterial pathogens
  - Reduce antibiotic use
- Reduce ancillary testing for diagnosis
  - Esoteric cultures
  - MRI, invasive testing
- Faster diagnosis for outbreak situations

Powell EA, et al. J Clin Virol. 2023 Dec;169:105612.
Hata DJ et al. J Appl Lab Med. 2023 Nov 2;8(6):1148-1159

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WHEN IS A GI VIRAL PANEL *NOT* APPROPRIATE

- Likelihood of detection of residual nucleic acid
  - May mask true etiology of disease
- Use as “Test of cure”
- Patients hospitalized ≥ 72 hours
  - Consider *C. difficile* instead
- Not recommended for normally healthy patients
  - Short duration of illness and supportive care

Powell EA, et al. J Clin Virol. 2023 Dec;169:105612.
Hata DJ et al. J Appl Lab Med. 2023 Nov 2;8(6):1148-1159

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GI PANELS AND PATIENT MANAGEMENT

Normal, healthy adult

Self limiting disease, testing NOT necessary

Pediatric patient

No specific guidelines for routine use of GIP's (IDSA)

Hospital Inpatient

< 3 days admission?

=/> 3 days admission?

C. difficile?

Outpatient

Unusual circumstances?

- ≥ 7-day duration
- Severe disease
- Patient population
- Travel history
- Outbreak exposure

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MAYO CLINIC LABORATORIES

Laboratory Testing for Infectious Causes of Diarrhea[1]

Community-acquired diarrhea, <7 days duration WITHOUT warning signs or risk factors for severe disease[2,3]

Testing not generally indicated

If diarrhea persists:

Community-acquired diarrhea ≥7 days duration
OR
Travel-related diarrhea
OR
Diarrhea with warning signs/risk factors for severe disease[2]

- GIP / Gastrointestinal Pathogen Panel, PCR, Feces[4]
  Consider OPE / Ova and Parasite, Travel History or Immunocompromised, Feces if traveler with >2 weeks of symptoms[5]

POSITIVE: No additional testing required unless clinical picture indicates

NEGATIVE: If diarrhea persists:

Consider:
- STL / *Enteric Pathogens* Culture, Feces
- GIAR / *Giardia* Antigen, Feces
- LCMSP / *Microsporidia* species, Molecular Detection, PCR, Varies (immunocompromised patients)
- OPE / Ova and Parasite, Travel History or Immunocompromised, Feces

Health care-associated diarrhea (onset after the 3rd inpatient day) or patients with recent antibiotic use

CDPCR / *Clostridioides difficile* Toxin, PCR, Feces

POSITIVE: No additional testing required unless clinical picture indicates

NEGATIVE: If diarrhea persists:

Use clinical judgment to guide the need for additional testing.

[1] This panel should NOT be used for chronic diarrhea.
[2] Warning signs and risk factors for severe disease include fever, bloody diarrhea, dysentery, severe abdominal pain, dehydration, hospitalization, and immunocompromised state.
[3] During the summer, consider ordering STFRP / Shiga Toxin, Molecular Detection, PCR, Feces on children with diarrhea even if they don't have frankly bloody diarrhea, are not toxic-appearing, and diarrhea has been present <7 days.
[4] GI Pathogen Panel tests for common bacterial, viral and parasitic causes of diarrhea
[5] Submit 3 stool collected on separate days for maximum sensitivity

Note: In outbreak scenarios with a known organism, consider ordering a specific test for that organism (CYCL / Cyclospora Stain, Feces; CRYPS / *Cryptosporidium* Antigen, Feces; GIAR / Giardia Antigen, Feces; bacterial stool culture)

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06/2023

4 CNS VIRAL PATHOGEN PANEL TESTING

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CNS PATHOGEN PANEL TARGETS

- *Escherichia coli* K1
- *Haemophilus influenzae*
- *Listeria monocytogenes*
- *Neisseria meningitidis*
- GBS, GAS
- *Streptococcus pneumoniae*
- *Mycoplasma pneumoniae*

- *Cryptococcus* sp.
  - *Neoformans* and *Gattii*

- 30 – 100 cases per 100,000 population
- 200,000 deaths yearly worldwide

- CMV
- Enterovirus
- HSV-1
- HSV-2
- Human herpesvirus 6 (HHV-6)
- Parechovirus (enterovirus
- Varicella zoster virus (VZV)

Boers SA et al. Eur J Clin Microbiol Infect Dis. 2024 Mar;43(3):511-516.
Akaishi T, et al. Acute Med Surg. 2023 Dec 29;11(1):e920.

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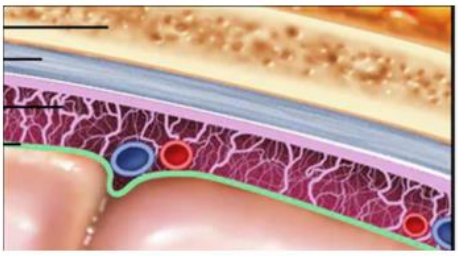
CNS PATHOGEN PANEL TARGETS

Meningitis:
- Inflammation of the meninges
- 4 – 30 cases/100,000
- Enterovirus



Encephalitis:
- Inflammation of brain parenchyma
- 3 – 7 cases/100,000
- HSV-1, HSV-2

- CMV
- Enterovirus
- HSV-1
- HSV-2
- Human herpesvirus 6 (HHV-6)
- Parechovirus (enterovirus)
- Varicella zoster virus (VZV)

Boers SA et al. Eur J Clin Microbiol Infect Dis. 2024 Mar;43(3):511-516.
Akaishi T, et al. Acute Med Surg. 2023 Dec 29;11(1):e920.

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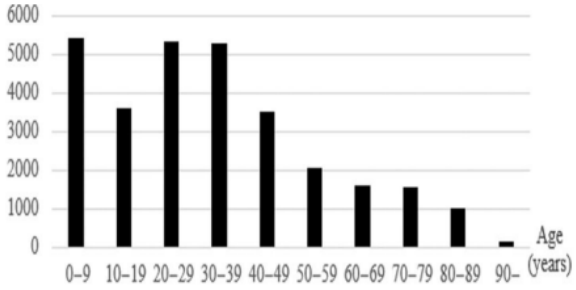
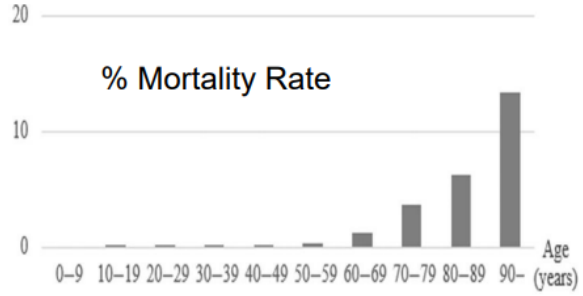
CNS VIRAL PATHOGENS

Viral meningitis cases Japan 2016 - 2022, N = 29,486





- CMV
- Enterovirus
- **HSV-1**
- **HSV-2**
- Human herpesvirus 6 (HHV-6)
- Parechovirus
- Varicella zoster virus (VZV)

Boers SA et al. Eur J Clin Microbiol Infect Dis. 2024 Mar;43(3):511-516
Akaishi T, et al. Acute Med Surg. 2023 Dec 29;11(1):e920.

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PERFORMANCE OF CNS PANEL – BIOFIRE ME

- Biofire ME Panel (BioMerieux Inc.)
  - FDA approved
  - 14 Targets
- 1 clinical site
- Adult and pediatric
- N = 161
- Compared to targeted PCR

Virus	PPA (95% CI)
Enterovirus	95.4 (83.7, 99.6)
HSV-1	73.1 (53.7, 86.5)
HSV-2	87.3 (75.7, 94.0)
CMV	100 (38.3, 100)
Parechovirus	Not tested
HHV-6	100 (51.1, 100)
VZV	100 (86.1, 100)
All viruses	94.8%

Liesman RM et al. 2018. J Clin Microbiol 56:10.1128/jcm.01927-17.

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PERFORMANCE OF CNS PANELS – QIASTAT DX ME

- QIAstat-Dx ME panel (Quagen Inc.)
  - CE marked only
  - 15 Targets
- 3 clinical sites
- Adult and pediatric
- N = 585
- Compared to Biofire ME

Virus	PPA (95% CI)	NPA
Enterovirus	77.8 (45.3–93.7)	99.8 (99.0–100.0)
HSV-1	100.0 (83.9–100.0)	100.0 (99,3–100.0)
HSV-2	91.3 (73.2–97.6)	99.6 (98.7–99.9)
Parechovirus	No data	100.0 (99.3–100.0)
HHV-6	90.0 (59.6–98.2)	99.7 (98.7–99.9)
VZV	94.6 (85.2–98.1)	99.6 (98.6–99.9) 99.8 (99.6–99.9)
All viruses	93.2 (87.1–96.5)	99.8 (99.6–99.9)

* CMV not included on this panel

Sundelin T et al. 2023.J Clin Microbiol 61:e00426-23.

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ANALYTICAL ISSUES THAT IMPACT CNS TESTING

- False negative HSV-1, HSV-2 early in course of infection
- False positive *S. pneumoniae*
- False negative *Cryptococcus*
- Vector borne viruses not included on current panels
  - WNV
  - St. Louis Encephalitis
- HIV not included

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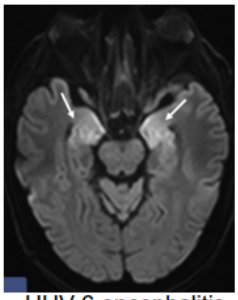
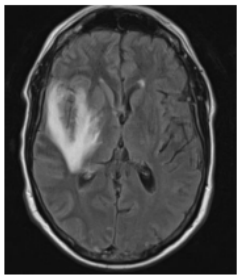
HUMAN HERPES VIRUS 6 – HHV 6

- HHV-6 testing – Detected but may not be clinically significant
- Chromosomal integration of HHV-6
- Subclinical reactivation of latent virus
- August 2017 – July 2017: N= 793
  - 60 (7.6%) positive for ≥ 1 target
  - 15 positive for HHV-6 (25%)
- Clinical relevance of HHV-6 unclear
- HSCT recipients at greatest risk
  - Distinct MRI changes
- Clinical judgement needed to judge significance
  - Provide interpretive comments on result report

Green DA. Clin Infect Dis. 2018 Sep 14;67(7):1125-1128.
Marcelis S, et al. J Belg Soc Radiol. 2022 Oct 10;106(1):93.



HHV-6 encephalitis



HSV-1 encephalitis

https://radiopaedia.org/articles/herpes-simplex-encephalitis?lang=us

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WHEN IS USE OF A CNS PANEL APPROPRIATE?

- Rapid diagnosis of encephalitis and meningitis
- Aids in antibiotic stewardship and length of hospital stay
- Culture negative meningitis/encephalitis
  - Availability of viral culture?
- Currently no set guidance for how or if testing should be limited as a stewardship approach,

Lewinski MA, et al.J Mol Diagn. 2023 Dec;25(12):857-875.
Tunkel AR et al, Clin Infect Dis. 2017 Mar 15;64(6):e34-e65.

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WHEN IS USE OF A CNS PANEL *NOT* APPROPRIATE?

2017 IDSA practice guidelines:
- "Nucleic acid amplification tests, such as PCR, on CSF may both increase the ability to identify a pathogen and decrease the time to making a specific diagnosis (weak, low)"

- No current guidelines for use of panels
  - Survey of 335 pediatric providers across 40 US states
  - 75% did not have guidance on appropriate usage of panels
  - 76% did not have guidance on interpretation of results of panels
- Testing in the absence of relevant clinical signs of meningitis/encephalitis

Tunkel AR, et al.Clin Infect Dis. 2017 Mar 15;64(6):e34-e65.
Rajbhandari P et al, BMC Infect Dis. 2022 Oct 31;22(1):811

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THINGS TO CONSIDER…..

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WHY IS THIS SO COMPLICATED?

- Tests are expensive and may not be readily available
  - Reserve use for patients who truly need them
- Limits on insurance reimbursement (US)
- Ease of use has led rapid adoption and potential overuse
- All analytes performed and reported
  - No flexibility to break up panels
    - Liaison Plex system allows for view and pay only for targets of interest

Graf EH, Pancholi P.. Curr Infect Dis Rep. 2020 Feb 6;22(2):5.

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MOLECULAR MULTIPLEX POINT/COUNTERPOINT
ADVANTAGES

- Syndromic approach useful when diagnosis cannot be made based on symptoms
- High analytical sensitivity and specificity
- Rapid time to result
- Superior to culture or antigen detection
- Must be a clear understanding of appropriate use and interpretation of test panel

Schreckenberger PC and McAdam, AJ. 2015. JCM 53:3110 – 3115
Hata DJ et al. J Appl Lab Med. 2023 Nov 2;8(6):1148-1159

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MOLECULAR MULTIPLEX POINT/COUNTERPOINT
DISADVANTAGES

- Panels not justified for rare pathogens, specific patient populations, or when clinical syndromes can be delineated
- Tests are not perfect
  - Understand the performance characteristics of each analyte to appreciate the positive and negative predictive value of the test
- Laboratory commitment to maintain test
  - Assay and software updates
  - Technologist competency
  - QC
  - Regulatory requirements

Schreckenberger PC and McAdam, AJ. 2015. JCM 53:3110 - 3115
Hata DJ et al. J Appl Lab Med. 2023 Nov 2;8(6):1148-1159

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IMPLEMENTATION OF MOLECULAR PANEL TESTING
LABORATORY CONSIDERATIONS

- Appropriate use of test
  - Consider patient population
- Clinical need
  - Collaboration with clinical services
  - What do they need?
- Specific requests
  - Support for specific clinical services
- Ability to acquire instrumentation
  - Cost
  - Laboratory capacity
  - Availability of technical support
- Cost benefit to laboratory
  - Revenue generation
  - Cost avoidance
- Workflow!
  - Test upon receipt or batch?
  - Shift based or 24/7?
  - Competency of personnel

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SUMMARY – RESPIRATORY PANEL TESTING

- 3 – 22 targets: bacteria, viruses
- Good overall performance; > 90% accuracy
- Rapid TAT can help target therapy and outbreak management
  - Influenza, SARS CoV-2
  - May not affect antibiotic usage
- Should not be used for asymptomatic patients/screening
- Quality of specimen very important
- Changes in target sequences could affect sensitivity and specificity of test

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SUMMARY – GI PANEL TESTING

- Detection of viruses with overlapping symptoms
- Ability to detect GI viruses that cannot be cultured
- Good overall performance ; >90% accuracy
  - Adenovirus
  - Norovirus
- Useful in high-risk patients; severe disease
  - Diarrhea ≥ 7 days
- Not recommended for normally healthy patients
  - Self-limiting
  - Supportive care only

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SUMMARY – CNS PANEL TESTING

- Rapid diagnosis of encephalitis/meningitis
  - Guide use of antiviral agents
- High negative predictive value of assays
  - "Rule-out" test
- Be aware of accuracy issues:
  - HSV- 1, HSV-2
  - Enterovirus
  - HHV-6
  - *Cryptococcus, S. pneumoniae*

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THANK YOU!

- Diana Meza
- Pan American Society for Clinical Virology (PASCV)
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  - Eleanor Powell PhD
- MCF Molecular Virology Laboratory

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