Innovations in Medical Education
Embracing the Technology
Teaching of Tomorrow
March 2022
UMass Chan Medical School
March 25-26, 2022
Disclosure

• I have no actual or potential conflict of interest in relation to this program/presentation.

• Specific programs and networks will be discussed as examples. These are examples only of materials available and are not specifically endorsed by the TOT program.
Objectives

Participants will be able to:

• Identify methods that learners are increasingly using for medical education
• Recognize opportunities to use innovative methods to better engage learners
• Recognize potential risks of innovative methods in medical education
Innovative/Novel Methods

What are some innovative/novel methods that learners are using?
### Table 3: Survey Responses for General Medical Knowledge and Point-of-Care Use

<table>
<thead>
<tr>
<th></th>
<th>General medical knowledge</th>
<th>Point-of-care use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency N = 662 (%)</td>
<td>Rated helpful (%)</td>
</tr>
<tr>
<td>Traditional resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board review resources</td>
<td>553 (84)</td>
<td>498 (90)</td>
</tr>
<tr>
<td>Clinical experience</td>
<td>660 (100)</td>
<td>621 (94)</td>
</tr>
<tr>
<td>Digital clinical resources</td>
<td>651 (98)</td>
<td>627 (96)</td>
</tr>
<tr>
<td>Journal articles</td>
<td>569 (86)</td>
<td>377 (66)</td>
</tr>
<tr>
<td>Pocket references</td>
<td>369 (56)</td>
<td>263 (71)</td>
</tr>
<tr>
<td>Professional guidelines</td>
<td>515 (78)</td>
<td>428 (83)</td>
</tr>
<tr>
<td>Textbooks (digital or paper)</td>
<td>372 (56)</td>
<td>257 (69)</td>
</tr>
<tr>
<td>Residency educational curriculum</td>
<td>561 (85)</td>
<td>359 (64)</td>
</tr>
<tr>
<td>Novel resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online blogs</td>
<td>149 (23)</td>
<td>85 (57)</td>
</tr>
<tr>
<td>Podcasts</td>
<td>388 (59)</td>
<td>290 (74)</td>
</tr>
<tr>
<td>Twitter</td>
<td>155 (23)</td>
<td>91 (59)</td>
</tr>
<tr>
<td>Wikipedia</td>
<td>339 (51)</td>
<td>222 (65)</td>
</tr>
<tr>
<td>YouTube</td>
<td>383 (58)</td>
<td>329 (86)</td>
</tr>
</tbody>
</table>

*Only residents who used a resource rated its helpfulness*
Textbooks are a Thing of the Past...

Figure 1 Resource use and perceived helpfulness by internal medicine residents for acquisition of either general medical knowledge or point-of-care learning. This graph demonstrates the combined percentage of IM residents who used each resource for either point of care decision-making or general medical knowledge and the percentage of residents who found each resource helpful among users.
Innovative/Novel Methods

• Digital Media
  • Social Media
  • Podcasts
  • Streaming Platforms
  • Visual Media
  • Blogs/Internet Search

• Other “Innovative” Methods
  • Simulation
  • Remote Access Learning
Digital Media / FOAM

• FOAM – Free Open Access Medical Education

“FOAM is a collection of resources, a community and an ethos. The FOAM community spontaneously emerged from the collection of constantly evolving, collaborative and interactive open access medical education resources being distributed on the web with one objective — to make the world a better place. FOAM is independent of platform or media — it includes blogs, podcasts, tweets, Google hangouts, online videos, text documents, photographs, facebook groups, and a whole lot more…. FOAM should not be seen as a teaching philosophy or strategy, but rather as a globally accessible crowd-sourced educational adjunct providing inline (contextual) and offline (asynchronous) content to augment traditional educational principles.”
Social Media

- Social Networks
  - “Me”
- Virtual Communities
  - “We”
- Digital Scholarship
  - #MedTwitter
  - #WomenInMedicine
  - #HealthEquity
Social Media

• Content available on many platforms
• Twitter one of most used now
  • Tweetorials – Quick informational series of tweets, often interactive

1/15

[How] does caffeine act as a diuretic?

I've long assumed that my morning cup of coffee directly results in my morning trip to the bathroom.

But, is it just the ingestion of fluid, or is there something specific about caffeine/coffee?

Grab a cup and let's find out. pic.twitter.com/oJjc88CaJh
6/12/20, 3:46 PM
When do you think is the best time to draw them?
- just after fever: 22.8%
- just before fever: 10.5%
- just before/chills/rigors: 15.4%

Figure 2. Hypothetical model for the febrile response. IL indicates interleukin; TNF, tumor necrosis factor; IFN, interferon; and PGE₂, prostaglandin E₂.
Polls/Surveys

Tony Breu [tony_breu] Sep 14 1/4
Why do we feel cold (i.e., experience “chills”) when we have a fever? Shouldn’t we feel hot?
And what are rigors?
Answers to these questions will help us better understand when we...

Tony Breu [tony_breu] Sep 14 2/4
Just after fever: 22.8%
Just after chills/rigors: 40.2%
Just before fever: 18.0%
Just before chills/rigors: 18.4%
4,677 votes - Final results

Tony Breu [tony_breu] Sep 14 3/4
Bacteria exposes us to exogenous pyrogens. For example, the cell wall of gram-negative rods contains lipopolysaccharide (LPS; endotoxin).
When injected into humans LPS induces fever. But, there is a 3-5 hour delay between exposure and peak fever.
pubmed.ncbi.nlm.nih.gov/4897938/

Tony Breu [tony_breu] Sep 14 4/4
During this period between bacteria and fever we may feel cold (i.e., we experience chills).
Why? There are at least two possible explanations.
1. Peripheral vasodilation + fall in skin temperature + “I’m cold”
2. Central signal + “I’m cold”

Which is it?
Vasodilation 43.3%
Central signal 56.7%
2,671 votes - Final results

Tony Breu [tony_breu] Sep 14 1/4
The delay between clinical bacteremia and fever was demonstrated in 1932 by Weiss and Olshen.
Their conclusion: Obtain blood cultures BEFORE fever. If only it were easy to predict future fever!
[Maybe we can as you’ll see in tweet 10 below.]
academic.oup.com/article-ab...

Tony Breu [tony_breu] Sep 14 2/4
In one study, subjects were placed in water at a stable temperature and injected with a pyrogen.
Before fever, they felt cold. This was despite a stable skin temperature.
Chills must therefore arise from some central action of pyrogens.
pubmed.ncbi.nlm.nih.gov/7188683/

Tony Breu [tony_breu] Sep 14 3/4
Should we say “culture of shakes” instead of “culture if spices”?
Maybe. Remember the order of events:
Bacteremia
Increased temperature set-point
“I’m cold” + Rigors
Fever
Chills and rigors should appear before a fever. And closer to the
Why do we feel cold (i.e., experience "chills") when we have a fever? Shouldn’t we feel hot?

And what are rigors?

Answers to these questions will help us better understand when we should obtain blood cultures.

When do you think is the best time to draw them?

- Just after fever: 22.8%
- Just before fever: 40.2%
- Just before chills/rigors: 18.0%
- Just before fever/rigors: 18.4%
- 4,677 votes - Final results

Bacteria exposes us to endogenous pyrogens. For example, the cell wall of gram-negative rods contains lipopolysaccharide (LPS; endotoxin).

When injected into humans, LPS induces fever. But, there is a 3-5 hour delay between exposure and peak fever.

During this period between bacteria and fever we may feel cold (i.e., we experience chills).

Why? There are at least two possible explanations.

- Peripheral vasodilatation + fall in skin temperature + "I’m cold"
- Direct central signal + "I’m cold"

Which is it?

Vasodilatation 43.3%
Central signal 56.7%
2,417 votes - Final results

In one study, subjects were placed in water at a stable temperature and injected with a pyrogen.

Before fever, they felt cold. This was despite a stable skin temperature.

Chills must therefore arise from some central action of pyrogens working with the brainstem/cholinergic system.

Bodies shaking even under a thick blanket is a far better predictor of bacteremia than...

...fever (even very high temperatures).

Before concluding, let me re-ask a version of the original question.

If you could obtain blood cultures at any of the following periods, which would you choose?

- Just after fever: 1.2%
- Just after chills/rigors: 46.9%
- Just before fever: 16.6%
- Just before chills/rigors: 35.4%

2,292 votes - Final results

The order of events: bacteremia and endogenous pyrogen exposure + increased temperature set-point + chills/rigors + fever

We may feel cold chills as a cue to drive behavioral change (e.g., put on a sweater),

Rigors promote rapid heat production

Please summarize Part 2

By the time fever occurs, bacteremia may have already cleared

Because rigors occur before fever (i.e., temporarily closer to bacteremia), they are better predictors of positive blood cultures.

Neither is perfect

Should we say "culture if chills" instead of "culture if spikes"?

Maybe. Remember the order of events:

- Bacteremia
- Increased temperature set-point
- "I’m cold" + "Rigors"
- Fever

Chills and rigors should appear before a fever. And closer to the
Bacteria expose us to exogenous pyrogens. For example, the cell wall of gram-negative rods contains lipopolysaccharide (LPS; endotoxin).

When injected into humans, LPS induces fever. But, there is a 3-5 hr delay between endotoxin and peak fever.

**Figure 2. Hypothetical model for the febrile response.** IL indicates interleukin; TNF, tumor necrosis factor; IFN, interferon; and PGE₂, prostaglandin E₂.

**Academic OUP**

Tony Breu @tony_breu - Sep 14

Why is there a delay between bacteraemia and fever?

There’s a lot to be done:
- LPS induces endogenous pyrogens (e.g., IL-1, TNF) which...
- Increase the hypothalamic set-point, resulting in...
- Thermogenesis, vasoconstriction, etc., and...

- Fever

Tony Breu @tony_breu - Sep 14

During this period between bacteraemia and fever we may feel cold (i.e., we experience chills).

Why? There are at least two possible explanations:
- Peripheral vasoconstriction = fall in skin temperature = “I’m cold”
- Direct central signal = “I’m cold”

Which is it?

Vasoconstriction 43.3%

Central signal 56.7%

2,415 votes - Final results

Tony Breu @tony_breu - Sep 14

In one study, subjects were placed in water at a stable temperature and injected with a pyrogen.

Before fever, they felt cold. This was despite a stable skin temperature.

Chills must therefore arise from extra-central action of pyrogens

Tony Breu @tony_breu - Sep 14

Should we say “culture if shakes” instead of “culture if spikes”?

Maybe. Remember the order of events:

- Bacteraemia
- Increased temperature set-point
- “I’m cold” signal
- Rigors
- Fever

Chills and rigors should appear before a fever. And closer to the...
Social Media – Other Uses

• Accessibility to Experts
  • Authors often post links to recently published articles
  • Can have active discussion regarding studies

• Opportunities for mentorship / Community of peers

• Resources for advocacy
Social Media – Pros + Cons

**PROS**
- Brief, high-yield teaching points
- Self-directed
- Relevant, up-to-date info

**CONS**
- Teaching points dictated by person posting
- ? Reliability / “Peer Reviewed”
- ? Issues of privacy
Podcasts

• Podcasts – Episodic series of spoken word audio files.

• TONS of medical podcasts out there aimed at every specialty and audience you can think of

• Broad scope for teachers and learners
  • Small scale “conference” – Can have content directed at learners but don’t need to sync up schedules of teachers and learners
  • Large scale with national audience
Types of Podcasts

- Modeling Clinical Reasoning & Diagnosis
- Multidisciplinary Expert Reviews
- Navigating Medical Ethics & History
- Expert Discussion of Recent Clinical Research
- Narrative Medicine

Rodman et al, Seminars in nephrology, 2020
Podcasts

- Can speak to every stage of learner
Podcasts – Pros + Cons

PROS
• Relevant, up-to-date info
• Self-directed
• Time flexibility
• Entertaining/Engaging

CONS
• ? Reliability
• Inability to directly answer questions
Video/Streaming Platforms

- Lots of videos with applicability to medical education
  - Procedural training
  - Exam findings
  - Interviews
  - Lectures


**Videos/Streaming – Pros + Cons**

**PROS**
- Self-directed
- Easy to find
- Can help demonstrate teaching points when not readily available in person

**CONS**
- ? Reliability
- ? Privacy
Visual Media

- Learners increasing using visual aids and media

**SKETCHY**

**Why visual media?**

- **Multichannel inputs**
  Visuals significantly increase memory over reading alone

- **Captures attention**
  Synoptic and efficient for learning

- **Illuminates complex concepts**

- **Promotes application**

- **Feasible**
  Relatively simple to create; expands teaching repertoire

Cooper et al, JGIM 2021
Blogs/Other Online Material

• Many different blogs and search engines learners are using

• Varying levels of reliability
Other Innovative Methods - Simulation

- Not a new concept but has continued to evolve with technology
- Many studies show benefits in teaching skills and procedures/surgeries with improvement in patient outcomes
  - Hands on learning often favored by the learners
  - Strategy to promote patient safety in medical education
  - Can address low frequency learning events that are high stakes
  - High value for both observer and participants
Simulation-based Medical Education at iCELS

Medical accuracy and emotional authenticity at the intersection of innovation and humanity, blueprinted to prioritize learning and safety.

**Task Trainers**
- Central line
- Airway
- IV arm
- CPR

**Extended Reality (VR/AR)**
- Virtual Reality/Augmented Reality
- Endoscopy Sim
- Da Vinci Robot Sim

**Screen-based Simulation**
- Software for physiology training
- Problem based learning software

**Human Patient Simulators**
- Full body simulators
- Infant to Adult
- Ultrasound simulators

**Standardized Patient**
- Objective Structured Clinical Examination (OSCE)
- Basic Semiology Training
- High Fidelity patient simulation

**Hybrid Simulation**
- Combining the standardized patient with any other modality

UMASS MEDICAL SCHOOL
INTERPROFESSIONAL CENTER FOR EXPERIENTIAL LEARNING AND SIMULATION
Other Innovative Methods - Simulation

• Great tool but requires a lot of resources
  • Physical space
  • Trained faculty and staff
  • Expensive equipment
Other Innovative Methods – Remote Access Learning

• Multiple platforms for remote learning and meetings

• PROS
  • Easier access for learners to participate
  • Increased faculty engagement
  • Innovative ways to involve learners

• CONS
  • Decreased personal interaction
  • Can be difficult to engage everyone involved
  • …some people are tired of it!!
The GNOME: Where Can We Fit These In?

Goals  Needs  Objectives  Methods  Evaluation
Innovative GNOME - Methods

Clinical knowledge
• All novel methods have potential applications

Clinical skills/procedures
• Videos
• Sim

Health Systems Science
• Social media
• Podcasts
• Blogs
Breakout Sessions

• Are there methods that we’ve discussed that you’re using or may plan to use in your teaching?
  • Podcasts, accounts, or other resources that you recommend?
• Other methods not discussed that you’ve found helpful?
• Do you have any hesitations or concerns with these methods in medical education?
Thank You!

- Special thanks to colleagues who actively use some of these methods and contributed to content in slides
  - Dr. Tony Breu
  - Dr. Adam Rodman
  - Dr. Christopher Chiu
  - Dr. Justin Berk
Resources

• Bernstein et al; A Nationwide Survey of Educational Resource Utilization and Perception Among Internal Medicine Residents; J Gen Intern med; 35(6); 1598-604

• Cooper et al; Visual Media in Medical Education; Journal of Grad Med Ed; June 2021

• Curran et al. A Review of Digital, Social, and Mobile Technologies in Health Professional Education. Journal for Cont in Edu in Health Professions; 37(3); 2017

• Rodman A., & Trivedi, S. Podcasting: A Roadmap to the Future of Medical Education. In Seminars in nephrology. May 2020