Innovations in Medical Education

Embracing the Technology

Teaching of Tomorrow

UMass Chan MEDICAL SCHOOL

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

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Innovative/Novel Methods

What are some innovative/novel methods that learners are using?

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Textbooks are a Thing of the Past…

Table 3 Survey Responses for General Medical Knowledge and Point-of-Care Use

	General medical knowledge		Point-of-care use	
	Frequency $N = 662$ (%)	Rated helpful* (%)	Frequency $N = 647$ (%)	Rated helpful* (%)
Traditional resources				
Board review resources	553 (84)	498 (90)	264 (41)	187 (71)
Clinical experience	660 (100)	621 (94)	-	-
Digital clinical resources	651 (98)	627 (96)	640 (99)	627 (98)
Journal articles	569 (86)	377 (66)	398 (62)	313 (79)
Pocket references	369 (56)	263 (71)	337 (52)	287 (85)
Professional guidelines	515 (78)	428 (83)	438 (68)	380 (87)
Textbooks (digital or paper)	372 (56)	257 (69)	164 (25)	109 (66)
Residency educational curriculum	561 (85)	359 (64)	-	-
Novel resources				
Online blogs	149 (23)	85 (57)	89 (14)	54 (61)
Podcasts	388 (59)	290 (74)	-	-
Twitter	155 (23)	91 (59)	50 (8)	27 (54)
Wikipedia	339 (51)	222 (65)	-	-
YouTube	383 (58)	329 (86)	-	-

Only residents who used a resource rated its helpfulness

Bernstein et al, JGIM 2021

Textbooks are a Thing of the Past...

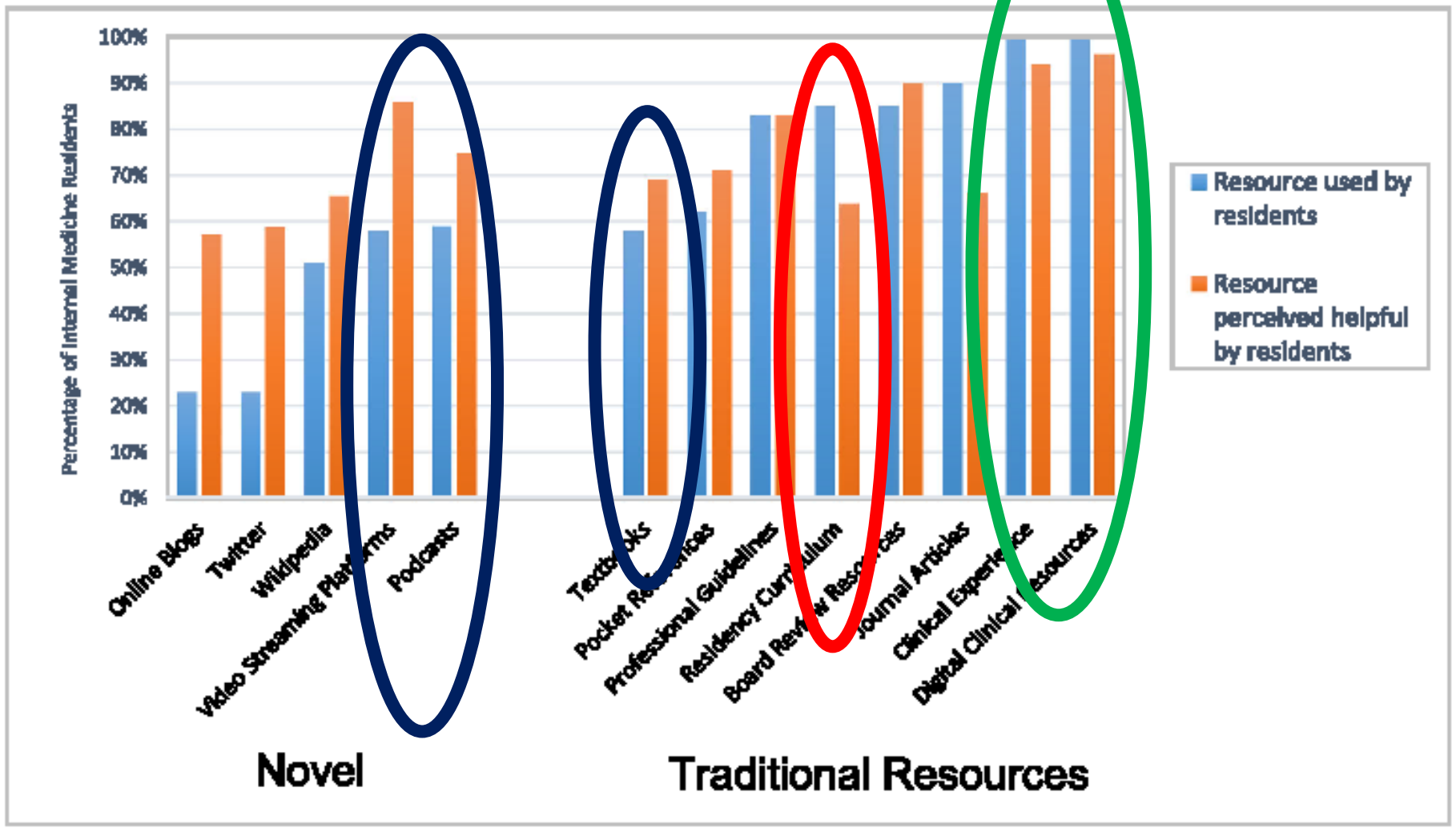

Figure 1 Resource use and perceived helpfulness by internal medicine residents for acquisition of either general medical knowledge or point-of-care learning. This graph demonstrates the combined percentage of IM residents who used each resource for either point of care decision-making or general medical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

Bernstein et al,JGIM 2021

Innovative/Novel Methods

Digital Media

- Social Media
- Podcasts
- Streaming Platforms
- Visual Media
- Blogs/Internet Search

Other “Innovative” Methods

- Simulation
- Remote Access Learning

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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****."*

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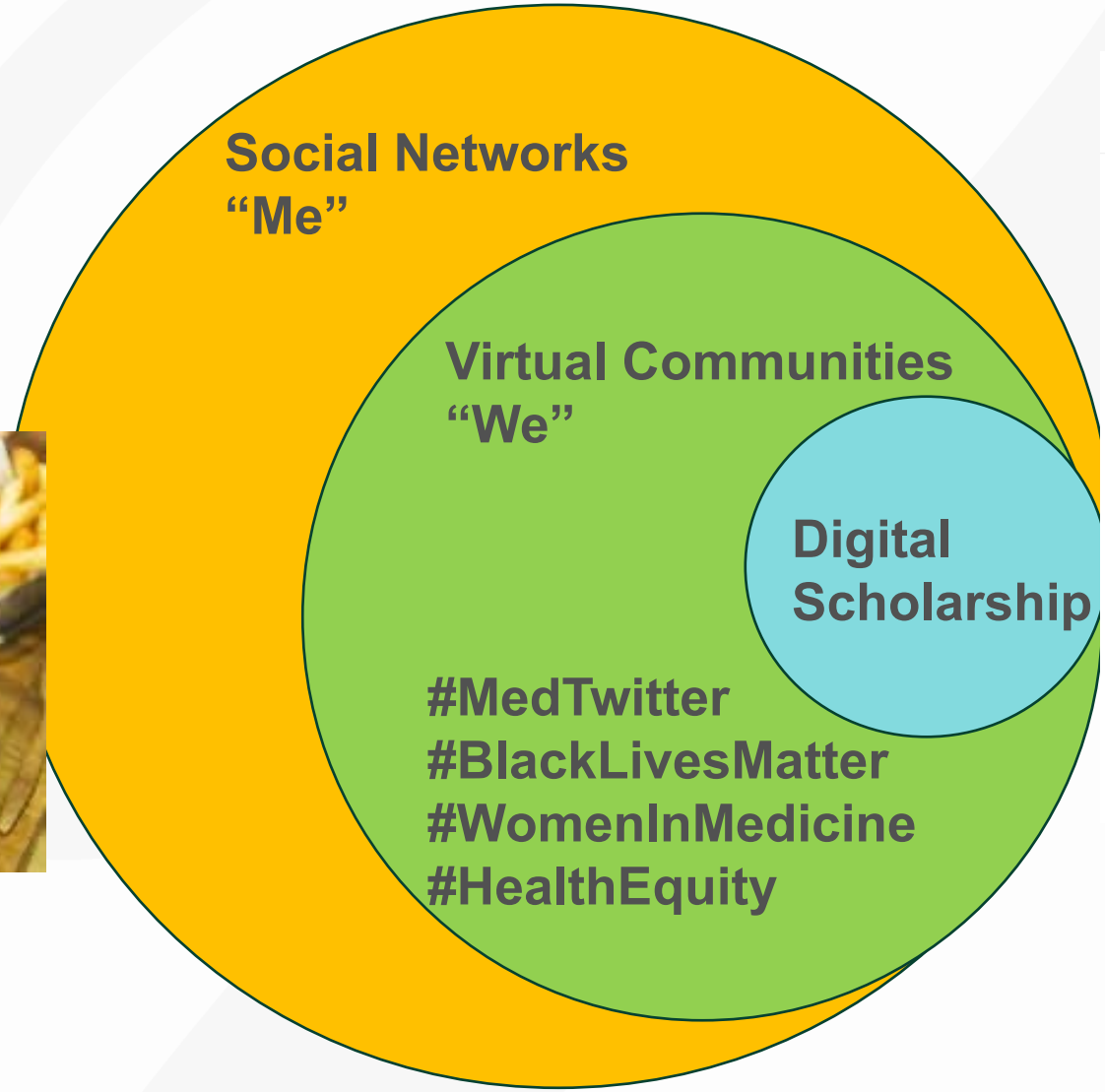
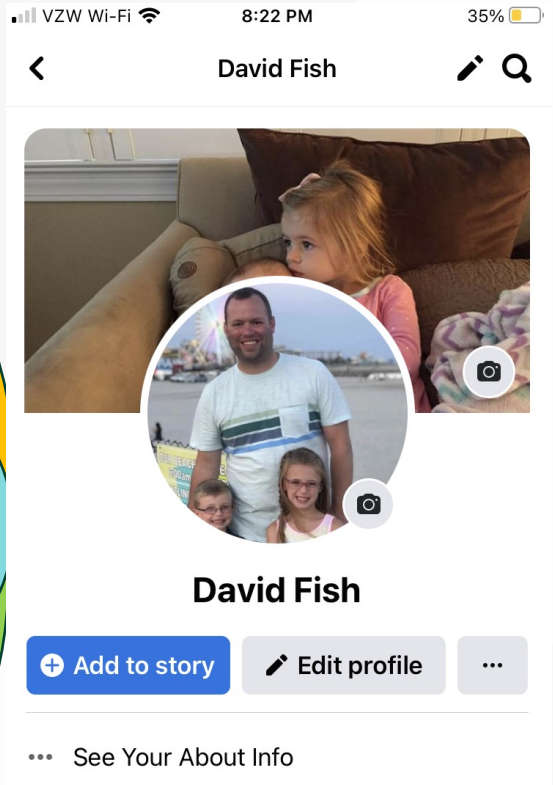
Digital Media / FOAM

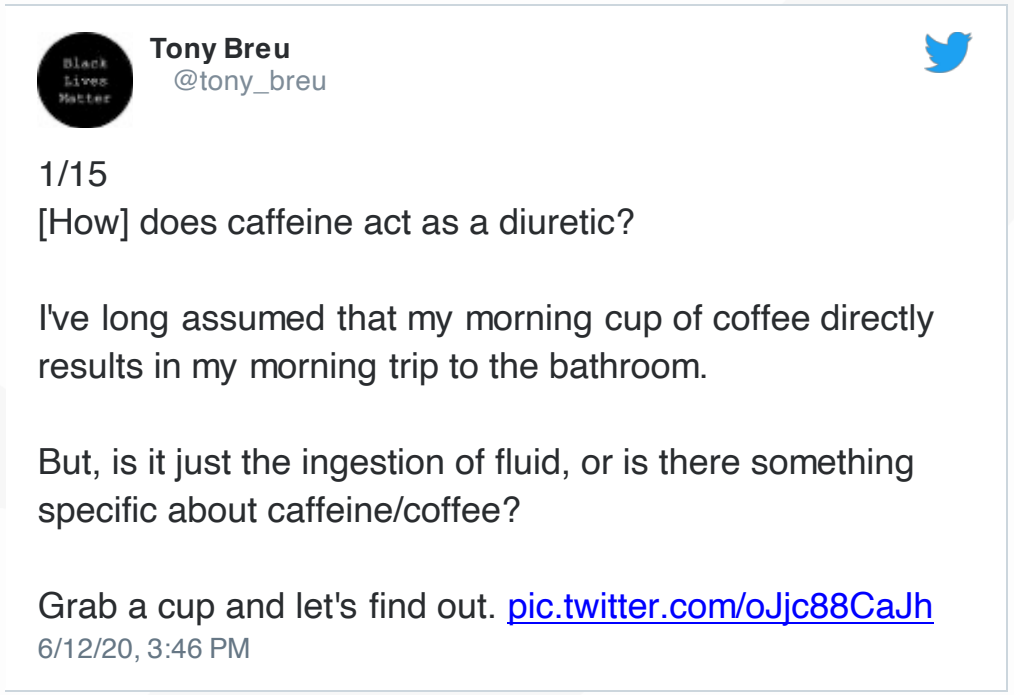
Social Media





Social Media

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



Posted Simultaneously

1

Breu @tony_breu · Sep 14

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at are rigors?

swers 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%
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4,677 votes · Final results

20 415 806

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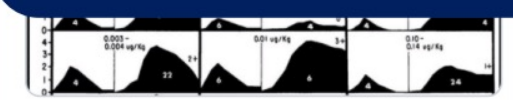

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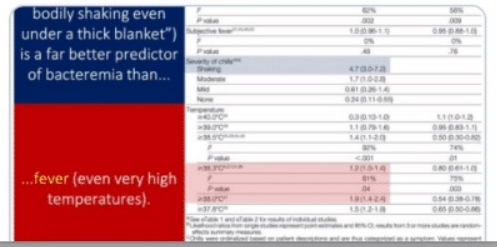

4

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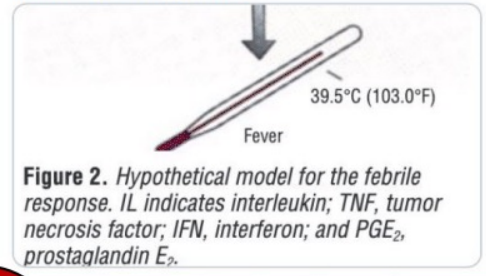

Figure 2. *Hypothetical model for the febrile response. IL indicates interleukin; TNF, tumor necrosis factor; IFN, interferon; and PGE$_2$, prostaglandin E$_2$.*

5

Central signal 56.7%

2,411 votes · Final results

1 5 27

6

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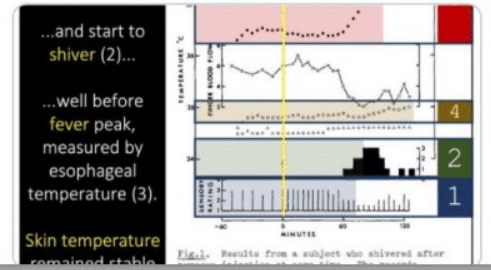

7

y Breu @tony_breu · Sep 14

ng to @tony_breu

uld an "I'm cold!" signal be sent?

gnal drives behavioral changes that aid with heat retention body aims to raise core temperature.

"I'm cold!" propels us to put on a blanket, seek shelter, etc.

We ARE cold compared with what our body wants us to be!

1 6 75

8

Breu @tony_breu · Sep 14

quire a rapid increase in temperature we might also nce violent shivering.

aking chills
RIGORS

The muscle contractions of rigors result in rapid heat production (thermogenesis) aiding fever onset.

PubMed.gov
Heat production from shivering - PubMed
Heat production from shivering
pubmed.ncbi.nlm.nih.gov

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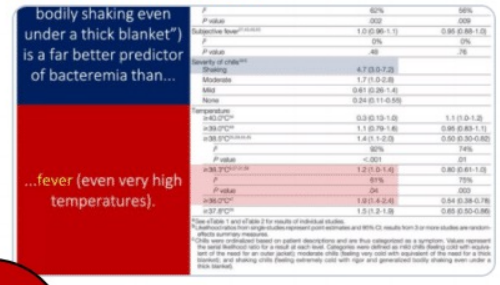
pubmed.ncbi.nlm.nih.gov/22851117/



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reu @tony_breu · Sep 14

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ABSTRACT

Objective: To determine whether the time lag between blood culture draw and the start of shaking chills is associated with blood culture positivity.
Methods: A prospective observational study was undertaken from January 2013 to March 2015 at a referral center in Okinawa, Japan. All enrolled patients were adults with an episode of shaking chills who were newly admitted to the division of infectious diseases. The study exposure was the time lag between blood culture draw and the most recent episode of shaking chills.
Results: Among patients whose blood cultures were obtained within 2 h after shaking chills started, the blood culture positivity was 53.6% (52/97), whereas among patients whose blood cultures were obtained after more than 2 h, the positivity was 37.6% (44/117) ($p = 0.019$). The adjusted odds ratio of blood culture positivity for samples drawn within 2 h after shaking chills was 1.88 (95% confidence interval 1.01–3.51, $p = 0.046$). *Escherichia coli* were the most frequently detected bacteria (58/105).
Conclusions: The positivity of blood cultures obtained within 2 h after the start of the most recent shaking chills was higher than that for blood cultures obtained after 2 h.

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12

reu @tony_breu · Sep 14

l question.

riods,

1.2%
46.9%
16.6%
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13

Breu @tony_breu · Sep 14

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1 10 76

14

y Breu @tony_breu · Sep 14

- SUMMARY - Part 2

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17 102

Posted 9/14/20

Polls/Surveys

Tony Breu @tony_breu · Sep 14

1/14
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

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

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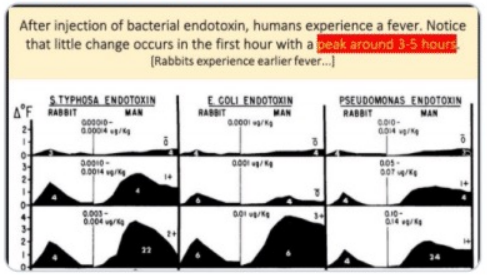

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The delay between clinical bacteremia and fever was demonstrated in 1932 by Weiss and Ottenberg.

Their conclusion: Obtain blood cultures BEFORE fever. If only it were easy to predict future fevers!

[Maybe we can as you'll see in tweet 10 below.]

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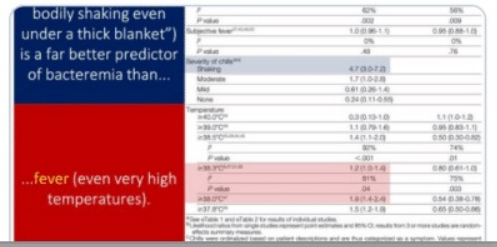

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There's a lot to be done!

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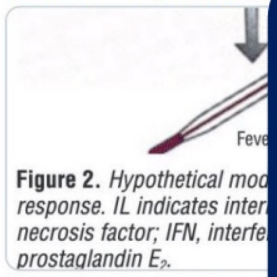

Figure 2. *Hypothetical mod... response. IL indicates inter... necrosis factor; IFN, interfe... prostaglandin E₂.*

1 2 57

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5/
During this period between bacteremia and fever we may feel cold (i.e., we experience chills).

Why? There are at least two possible explanations.

1 Peripheral vasoconstriction → fall in skin temperature → "I'm cold!"
2 Direct central signal → "I'm cold!"

Which is it?

Vasoconstriction	43.3%
Central signal	**56.7%**

2,411 votes · Final results

1 5 27

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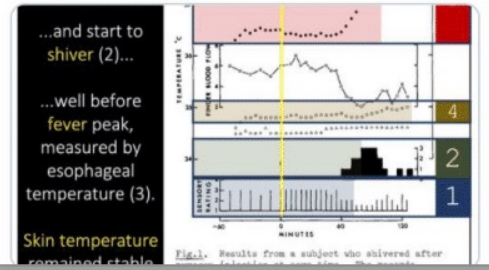

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Why would an "I'm cold!" signal be sent?

This signal drives behavioral changes that aid with heat retention as our body aims to raise core temperature.

"I'm cold!" propels us to put on a blanket, seek shelter, etc.

...dy wants us to be!

...might also

...heat production

...- PubMed

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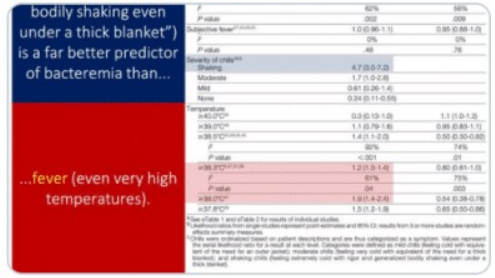

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Chills and rigors should appear before a fever. And closer to the

Tony Breu @tony_breu · Sep 14

11/
While rigors occur closer to bacteremia than fever (and therefore better predict positive cultures), there is still a delay. They're not perfect.

But, if you obtain blood cultures within 2 hours of rigors there is increased likelihood of positivity.

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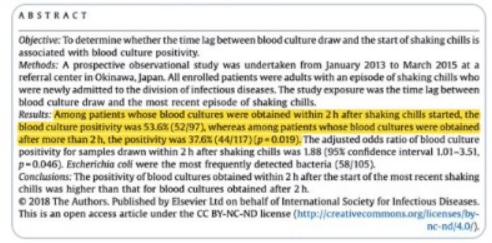
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1 13 69

Tony Breu @tony_breu · Sep 14

12/

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

Tony Breu @tony_breu · Sep 14

13/ - SUMMARY - Part 1
- The order of events: bacteremia and exogenous pyrogen exposure → increase 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

1 10 76

Tony Breu @tony_breu · Sep 14

14/14 - SUMMARY - Part 2
- By the time fever occurs, bacteremia may have already cleared
- Because rigors occur before fever (i.e., temporally closer to bacteremia), they are better predictors of positive blood cultures
- Neither is perfect

6 17 102

Posted 9/14/20

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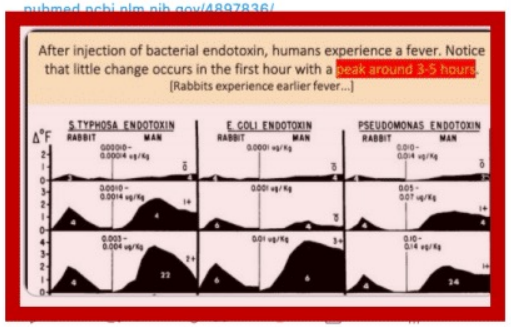

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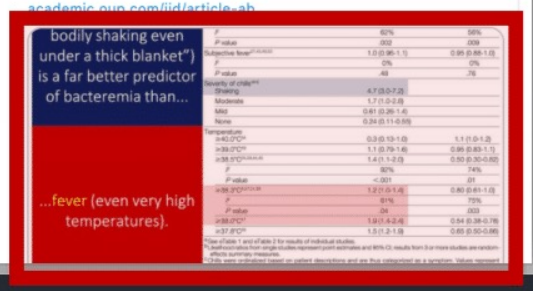

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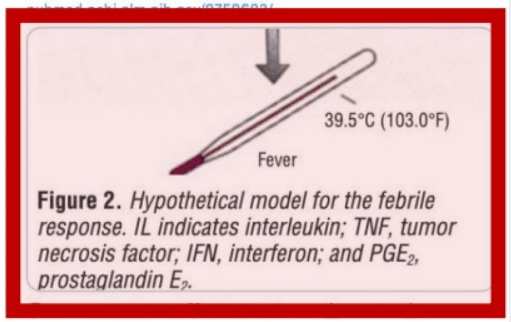

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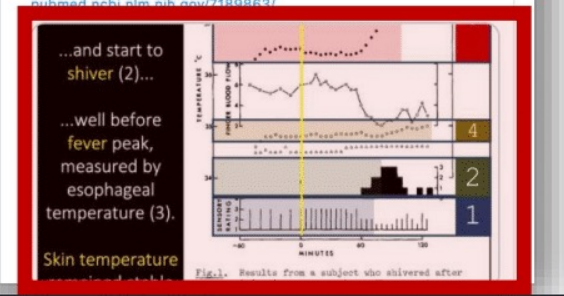

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Graphics

PubMed.gov Heat production from shivering
pubmed.ncbi.nlm.nih.gov

1 3 60

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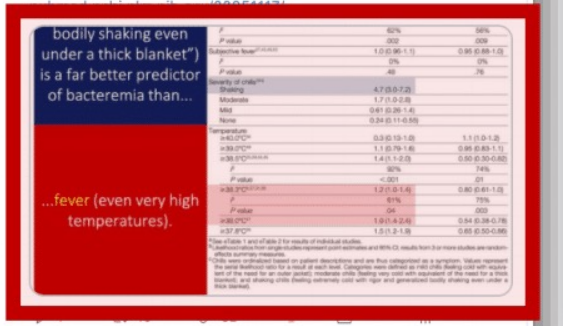

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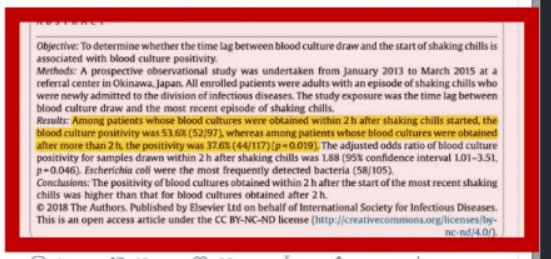
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Conclusions: The positivity of blood cultures obtained within 2 h after the start of the most recent shaking chills was higher than that for blood cultures obtained after 2 h.
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1 13 69

Tony Breu @tony_breu · Sep 14

12/
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

1 4 18

Tony Breu @tony_breu · Sep 14

13/ - SUMMARY - Part 1
- The order of events: bacteremia and exogenous pyrogen exposure → increase 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

1 10 76

Tony Breu @tony_breu · Sep 14

14/14 - SUMMARY - Part 2
- By the time fever occurs, bacteremia may have already cleared
- Because rigors occur before fever (i.e., temporally closer to bacteremia), they are better predictors of positive blood cultures
- Neither is perfect

6 17 102

Posted 9/14/20

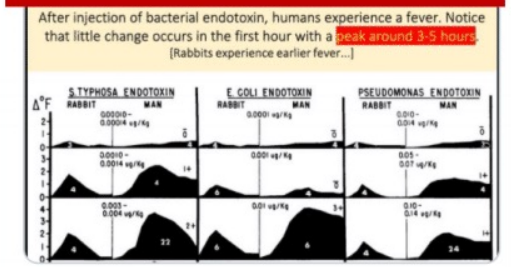
Hyperlinks

Tony Breu @tony_breu · Sep 14

2/
Bacteremia 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/4897836/



1 4 58

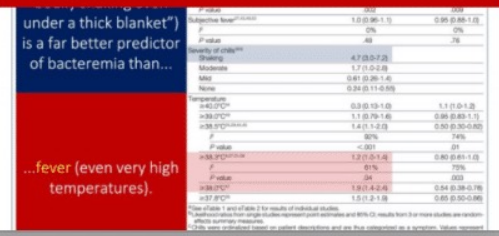
Tony Breu @tony_breu · Sep 14

3/
The delay between clinical bacteremia and fever was demonstrated in 1932 by Weiss and Ottenberg.

Their conclusion: Obtain blood cultures BEFORE fever. If only it were easy to predict future fevers!

[Maybe we can as you'll see in tweet 10 below.]

academic.oup.com/jid/article-ab...



Tony Breu @tony_breu · Sep 14

4/
Why is there a delay between bacteremia and fever?

There's a lot to be done!

- LPS induces endogenous pyrogens (e.g., IL-6) which...
- Increase the hypothalamic set-point, resulting in...
- Thermogenesis, vasoconstriction, etc., and...
- Fever

pubmed.ncbi.nlm.nih.gov/9759682/

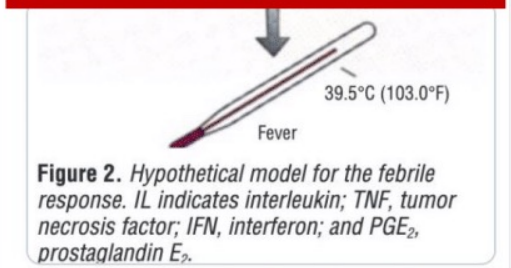


Figure 2. *Hypothetical model for the febrile response. IL indicates interleukin; TNF, tumor necrosis factor; IFN, interferon; and PGE_2, prostaglandin E_2.*

1 2 57

Tony Breu @tony_breu · Sep 14

5/
During this period between bacteremia and fever we may feel cold (i.e., we experience chills).

Why? There are at least two possible explanations.

1 Peripheral vasoconstriction → fall in skin temperature → "I'm cold!"
2 Direct central signal → "I'm cold!"

Which is it?

Vasoconstriction 43.3%
Central signal 56.7%

2,411 votes · Final results

1 5 27

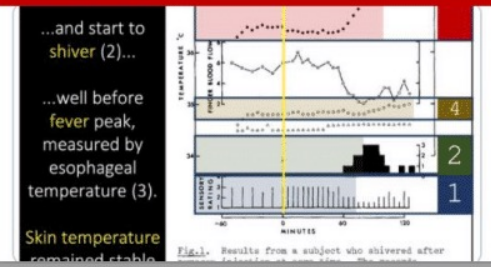
Tony Breu @tony_breu · Sep 14

6/
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/7189863/



Tony Breu @tony_breu · Sep 14
Replying to @tony_breu

7/
Why would an "I'm cold!" signal be sent?

This signal drives behavioral changes that aid with heat retention as our body aims to raise core temperature.

"I'm cold!" propels us to put on a blanket, seek shelter, etc.

We ARE cold compared with what our body wants us to be!

1 6 75

Tony Breu @tony_breu · Sep 14

8/
If we require a rapid increase in temperature we might also experience violent shivering.

aka shaking chills
aka RIGORS

The muscle contractions of rigors result in rapid heat production (thermogenesis) aiding fever onset.

PubMed.gov
Heat production from shivering - PubMed
Heat production from shivering
pubmed.ncbi.nlm.nih.gov

1 3 60

Tony Breu @tony_breu · Sep 14

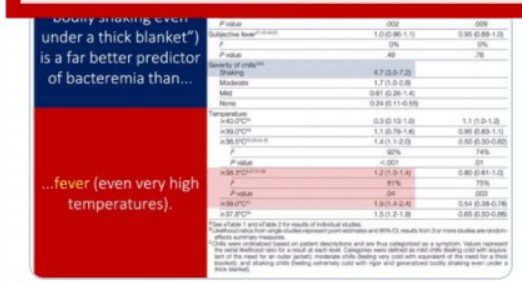
9/
We don't always require the rapid-onset fever that rigors produce. But bacteremia is a scenario where it might make sense.

So, is there an association between rigors and bacteremia?

Yes!

In fact, rigors predictor bacteremia better than fever.

pubmed.ncbi.nlm.nih.gov/22851117/



1 16 82

Tony Breu @tony_breu · Sep 14

10/
Should we say "culture if shakes" instead of "culture if spikes"?

Maybe. Remember the order of events:

1 Bacteremia
2 Increased temperature set-point
3 "I'm cold" and 4 Rigors
5 Fever

Chills and rigors should appear before a fever. And closer to the

Tony Breu @tony_breu · Sep 14

11/
While rigors occur closer to bacteremia than fever (and therefore better predict positive cultures), there is still a delay. They're not perfect.

But, if you obtain blood cultures within 2 hours of rigors there is increased likelihood of positivity.

pubmed.ncbi.nlm.nih.gov/30059771/

Objective: To determine whether the time lag between blood culture draw and the start of shaking chills is associated with blood culture positivity.
Methods: A prospective observational study was undertaken from January 2013 to March 2015 at a referral center in Okinawa, Japan. All enrolled patients were adults with an episode of shaking chills who were newly admitted to the division of infectious diseases. The study exposure was the time lag between blood culture draw and the most recent episode of shaking chills.
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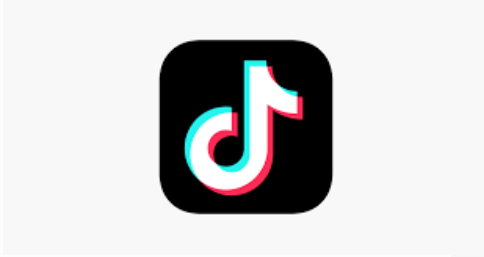
6 17 102

Posted 9/14/20

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

UMass Chan MEDICAL SCHOOL

Why Podcasts

Widely accepted and used by learners

92% reported the podcast made it easier to find time to study, 97% reported that it helped them learn new information, 97% reported that it helped them apply knowledge clinically and 100% reported that they would recommend it to others

McCarthy & Porada 2020

Evidence of knowledge gain

After listening to 10 minute podcast lessons, scores on stroke quiz increased from 86% to 92%, scores on bronchiolitis quiz increased from 69% to 92%

Alla and Kirkman, 2014

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

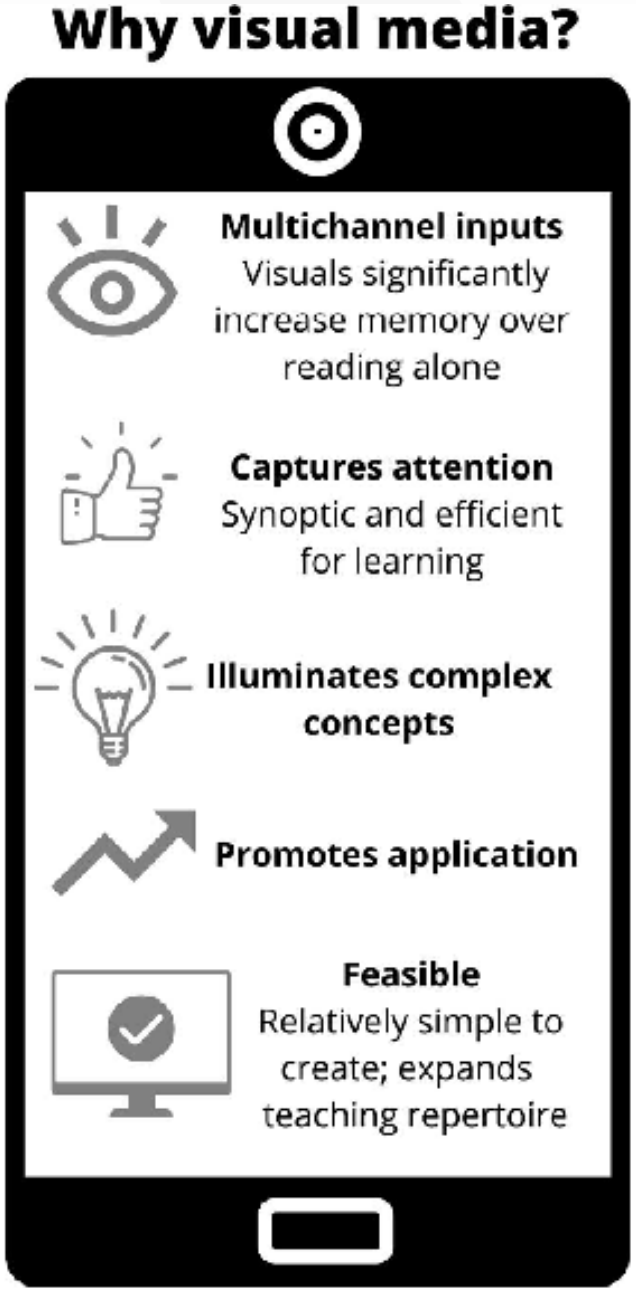
CONS

- ? Reliability
- ? Privacy

Visual Media

- Learners increasing using visual aids and media

SKETCHY

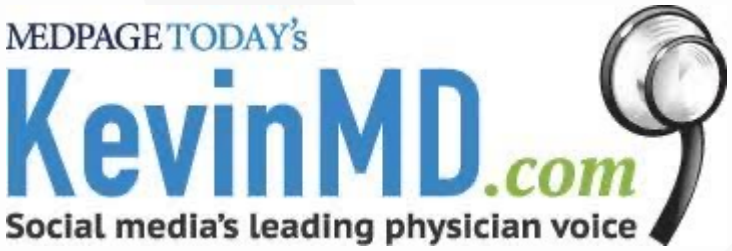


Cooper et al, JGIM 2021

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

UMass Chan MEDICAL SCHOOL

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

iCELS

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 Contin Edu in Health Professions; 37(3); 2017
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