MARS is calling

CLINID conference
Hunter Ratliff
04/16/2025

Ages, dates, and other identifying information may have been changed
I have no conflict of interest in relation to this presentation

Shortcuts

Part A: (inpatient)
MARS #1: immunocompromise | GI microbiome

Part B (outpatient): Clinic time | rash | eos timeline
MARS #2: case | Mir's water | pathogen biofilms

Part C (readmission): Alpha-gal
MARS #2: case | LSMMG | nematodes | meds

Takeaway slide

Case 1: HPI

A **73 y/o M** with PMH including CLL, CAD, OSA, seizures p/w **cardiogenic shock**

Case 1: HPI

A **73 y/o M** with PMH including CLL, CAD, OSA, seizures p/w **cardiogenic shock**

- Admitted to OSH with **three weeks** of **dyspnea**
- Had been also having **chest pain** while shoveling snow
- **?diaphoresis** (but not with chest pain)

Case 1: HPI

A **73 y/o M** with PMH including CLL, CAD, OSA, seizures p/w **cardiogenic shock**

- Admitted to OSH with **three weeks** of **dyspnea**
- Had been also having **chest pain** while shoveling snow
- **?diaphoresis** (but not with chest pain)

Not much else in the initial H&P, since patient was in florid shock

Case 1: HPI

A **73 y/o M** with PMH including CLL, CAD, OSA, seizures p/w **cardiogenic shock**

- Admitted to OSH with **three weeks** of **dyspnea**
- Had been also having **chest pain** while shoveling snow
- **?diaphoresis** (but not with chest pain)

Not much else in the initial H&P, since patient was in florid shock

CBC	Result
WBC	**36**
Hgb	16
Platelets	176
Creatine	1.46
Lactate	**3.7**

Baseline is 13-20

Case 1: HPI

A **73 y/o M** with PMH including CLL, CAD, OSA, seizures p/w **cardiogenic shock**

- Admitted to OSH with **three weeks** of **dyspnea**
- Had been also having **chest pain** while shoveling snow
- **?diaphoresis** (but not with chest pain)

Not much else in the initial H&P, since patient was in florid shock

CBC	Result
WBC	36
Hgb	16
Platelets	176
Creatine	1.46
Lactate	3.7

Baseline is 13-20

Troponin	
Inital	1,200
+40 min	5,200
+2 hr	11,300
+8 hr	24,700

Hemodynamics

Levophed: 0.13 (mcg/kg/min)
Milrinone: 0.125 (mcg/kg/min)

Case 1: HPI

A **73 y/o M** with PMH including CLL, CAD, OSA, seizures p/w **cardiogenic shock**

- Admitted to OSH with **three weeks** of **dyspnea**
- Had been also having **chest pain** while shoveling snow
- **?diaphoresis** (but not with chest pain)

Not much else in the initial H&P, since patient was in florid shock

CBC	Result
WBC	36
Hgb	16
Platelets	176
Creatine	1.46
Lactate	**3.7**

Baseline is 13-20

Troponin	
Inital	**1,200**
+40 min	**5,200**
+2 hr	**11,300**
+8 hr	**24,700**

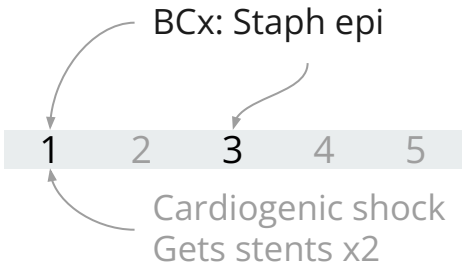
Emergent cath

- Confirms shock is cardiogenic (cardiac index **1.42**)
- 99% stenosis of RCA
- Placed stents x2

Case 1: HPI

A **73 y/o M** with PMH including CLL (has port), CAD, OSA, seizures p/w **cardiogenic shock**

- **Staph epi** grows in both sets of blood cultures, twice
  - Unofficial **time to positivity** implies **port infection**

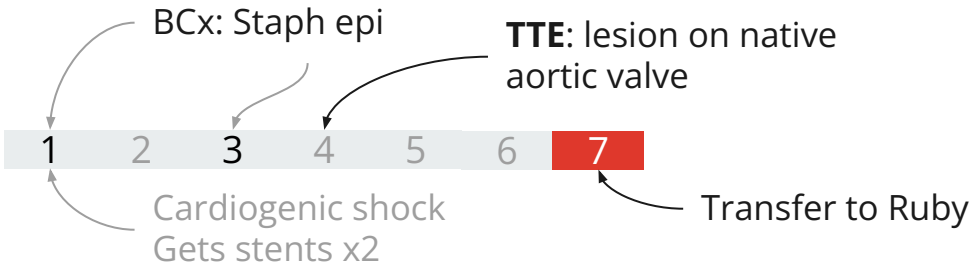


	Port	Peripheral
Collected	9:02 am	6:07 am
TTP	**13 hrs**	21 hrs

Case 1: HPI

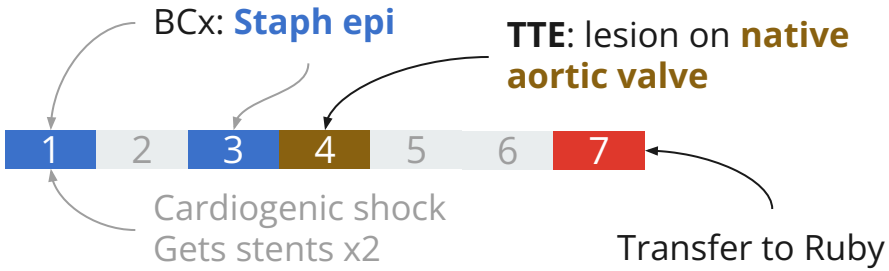
A **73 y/o M** with PMH including CLL (has port), CAD, OSA, seizures p/w **cardiogenic shock**

- **Staph epi** grows in both sets of blood cultures, twice
  - Unofficial **time to positivity** implies **port infection**
- Transthoracic echo: Echodensity on **aortic valve**
  - Native aortic valve



Case 1: Summary

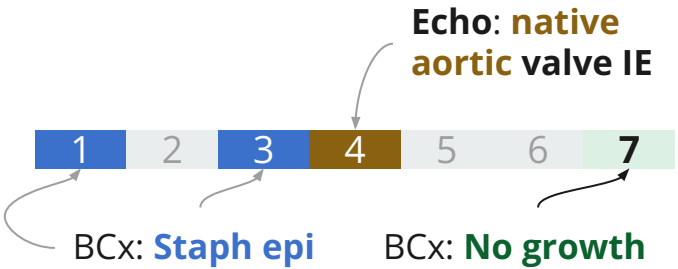
A **73 y/o M** with PMH including CLL (has port), CAD/PAD, OSA, seizures p/w **cardiogenic shock** & NSTEMI s/p stenting. Found to have persistent **staph epi bacteremia** and echodensity on **native aortic** valve



Case 1: Transfer to Ruby

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**.

- Repeat **blood cultures no growth**
  - On **day 7 of vancomycin**



Discharge summary

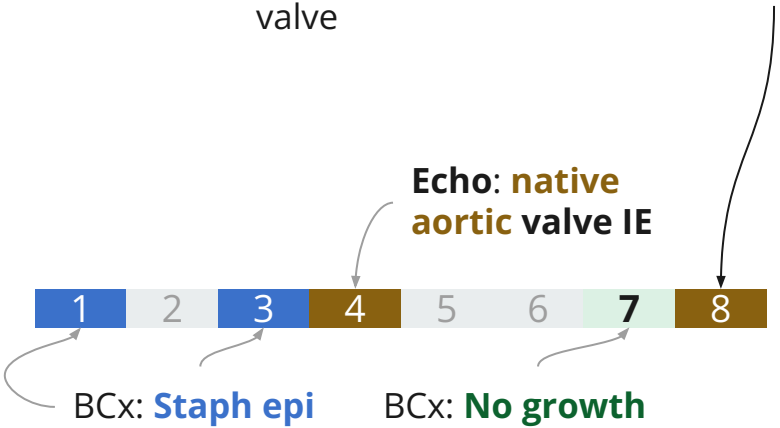
Patient underwent cardiac catheterization on [redacted] which showed 3 vessel disease. Cardiothoracic surgery was consulted and recommended PCI to RCA and mid LAD. Due to cardiogenic shock he was initiated on Levophed and milrinone. Impella was considered but vascular access was difficult.

Swan-Ganz catheter was placed. Blood cultures were obtained **from his port** and were positive for **staphylococcus epidermidis** for which ID was consulted.

Case 1: Transfer to Ruby

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**.

- Repeat **blood cultures** **no growth**
  - On **day 7 of vancomycin**
- **Transesophageal echo**: **1x1cm lesion** on aortic valve



Discharge summary

Patient underwent cardiac catheterization on [redacted] which showed 3 vessel disease. Cardiothoracic surgery was consulted and recommended PCI to RCA and mid LAD. Due to cardiogenic shock he was initiated on Levophed and milrinone. Impella was considered but vascular access was difficult.

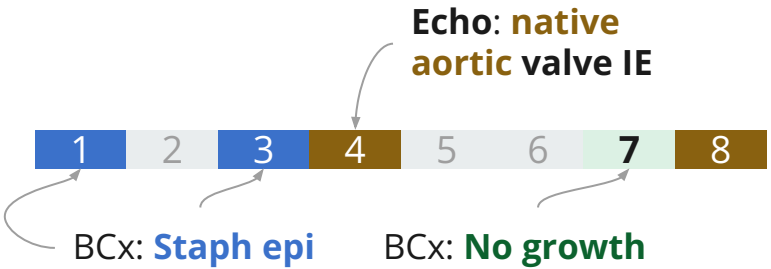
Swan-Ganz catheter was placed. Blood cultures were obtained **from his port** and were positive for **staphylococcus epidermidis** for which ID was consulted.

Case 1: Hardware

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**.

Discharge summary mentions **EVAR**

- 5 years ago, had endovascular aneurysm repair for AAA



Discharge summary

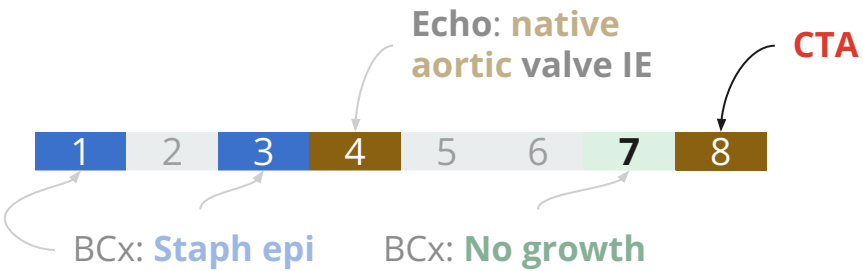
Patient underwent cardiac catheterization on [redacted] which showed 3 vessel disease. Cardiothoracic surgery was consulted and recommended PCI to RCA and mid LAD. Due to cardiogenic shock he was initiated on Levophed and milrinone. **Impella was considered but vascular access was difficult due to his EVAR for Impella or IABP**. Swan-Ganz catheter was placed. Blood cultures were obtained **from his port** and were positive for **staphylococcus epidermidis** for which ID was consulted.

Case 1: Hardware

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**.

Discharge summary mentions **EVAR**

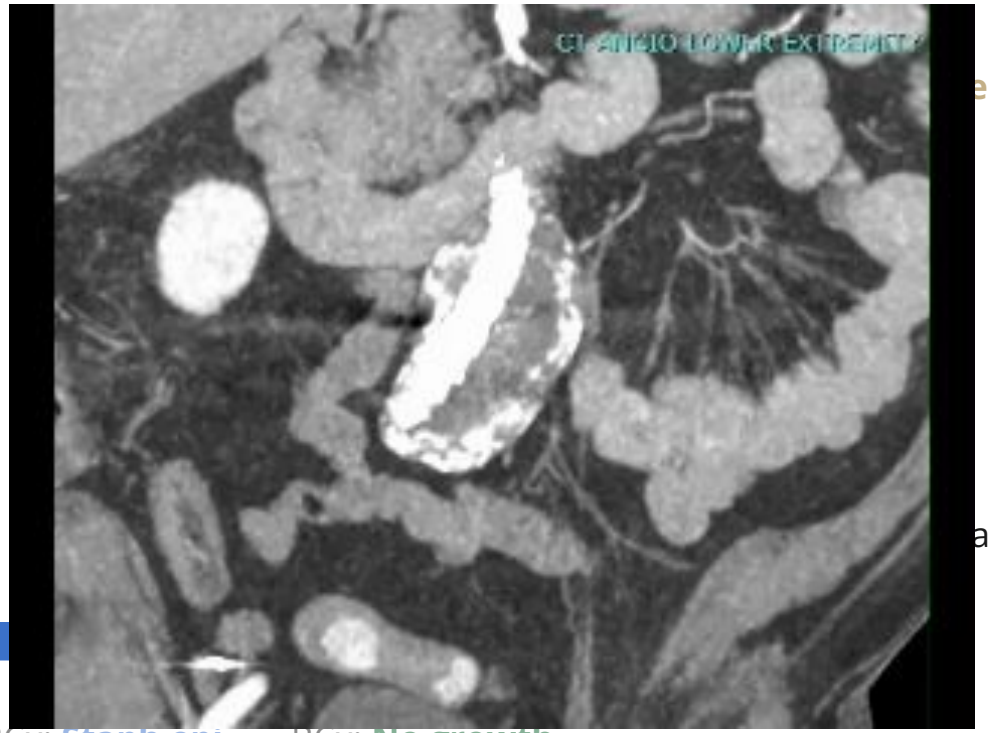
- 5 years ago, had endovascular aneurysm repair for AAA
- **No imaging done** as of yet (only had CTA PE)



Discharge summary

Patient underwent cardiac catheterization on [redacted] which showed 3 vessel disease. Cardiothoracic surgery was consulted and recommended PCI to RCA and mid LAD. Due to cardiogenic shock he was initiated on Levophed and milrinone. **Impella was considered but vascular access was difficult due to his EVAR for Impella or IABP**. Swan-Ganz catheter was placed. Blood cultures were obtained **from his port** and were positive for **staphylococcus epidermidis** for which ID was consulted.

Case 1: Hardware



CTA A/P with runoff

Indication: Hx EVAR, preoperative exam

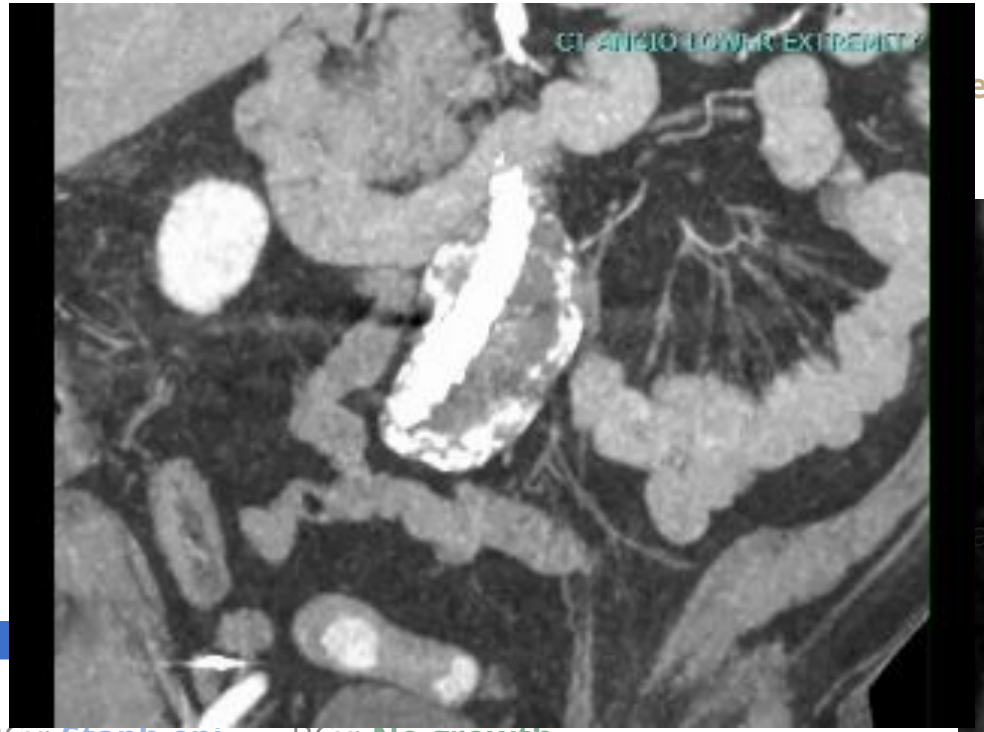
Aortoiliac: Postsurgical changes from EVAR for infrarenal abdominal aortic aneurysm. Aneurysm sac at iliac bifurcation measures 5.7 cm, **unchanged from [prior scans]**.

1

BCx: **Staph epi**

BCx: **No growth**

Case 1: Hardware



CTA A/P with runoff

Spleen: evolving **splenic infarct**

Kidneys: Right **renal infarct**

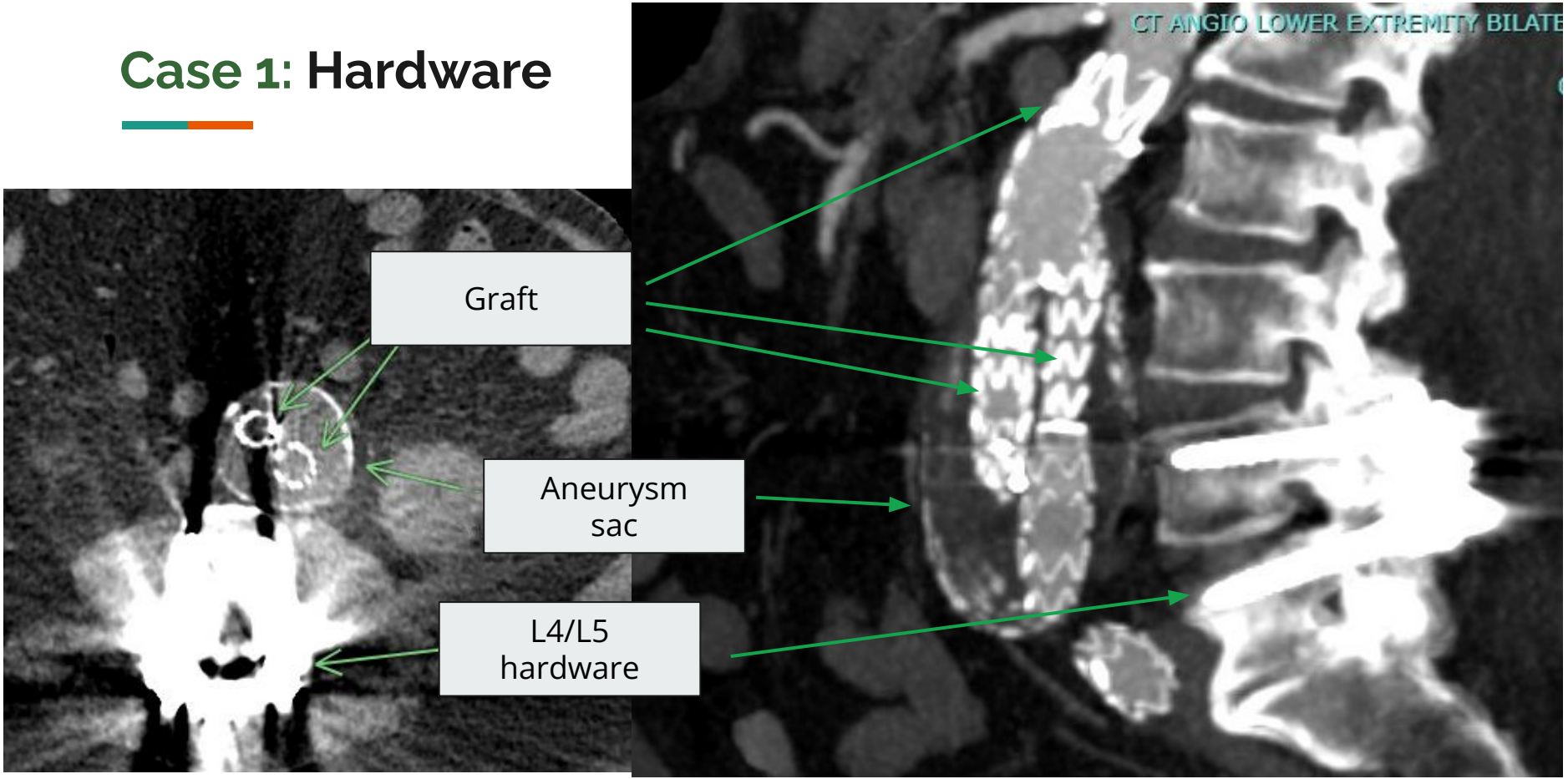
Bones: L4-L5 **posterior spinal fusion**

1

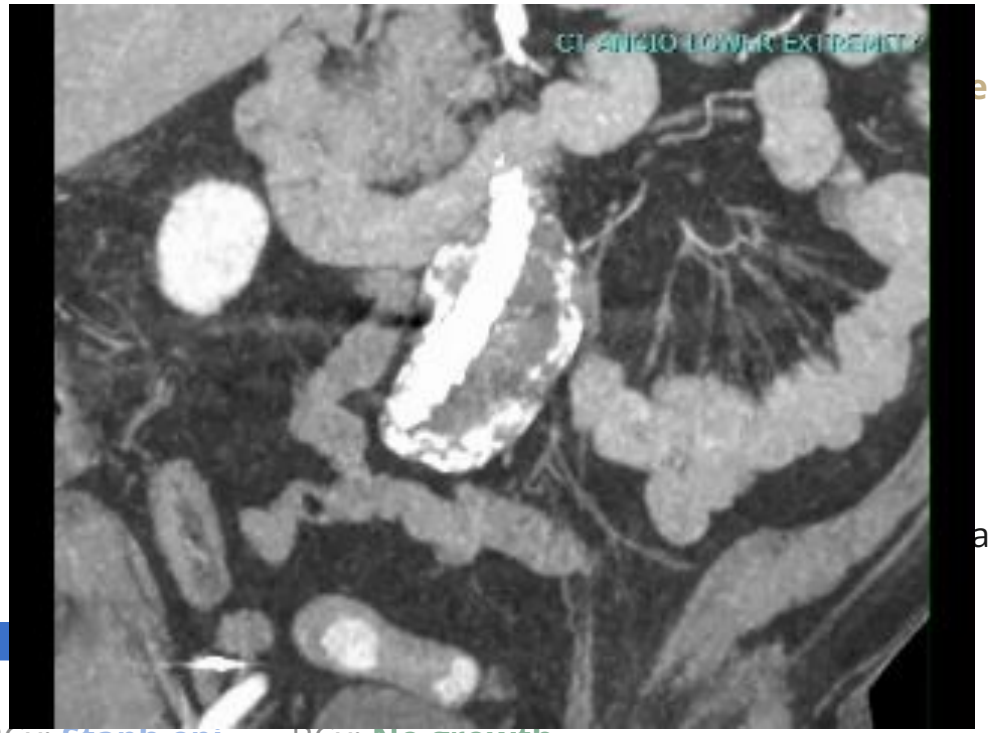
BCx: **Staph epi**

BCx: **No growth**

Case 1: Hardware



Case 1: Hardware



CTA A/P with runoff

Indication: Hx EVAR, preoperative exam

Aortoiliac: Postsurgical changes from EVAR for infrarenal abdominal aortic aneurysm. Aneurysm sac at iliac bifurcation measures 5.7 cm, **unchanged from [prior scans]**.

Spleen: evolving **splenic infarct**

Kidneys: Right **renal infarct**

Bones: L4-L5 **posterior spinal fusion**

IMPRESSION: **stable size** of infrarenal abdominal aortic aneurysm sac. Evolving splenic and renal infarcts

1

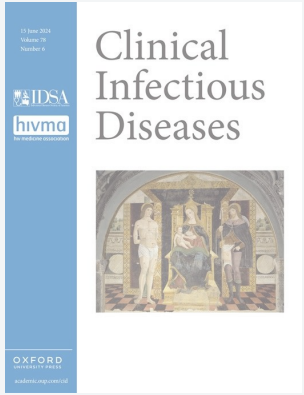
BCx: **Staph epi** BCx: **No growth**

Vascular Graft Infections (VGI)

Objectives

- **Accurately diagnose & categorize** (suspected & confirmed) **VGIs**
- Describe surgical management
- tment options &

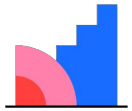
Recall my prior presentation
From October of 2024
https://www.hunterratliff1.com/talk/cid-2024-10-03/



DeSimone et a
Clinical Infectious Diseases
[citation 2.1]

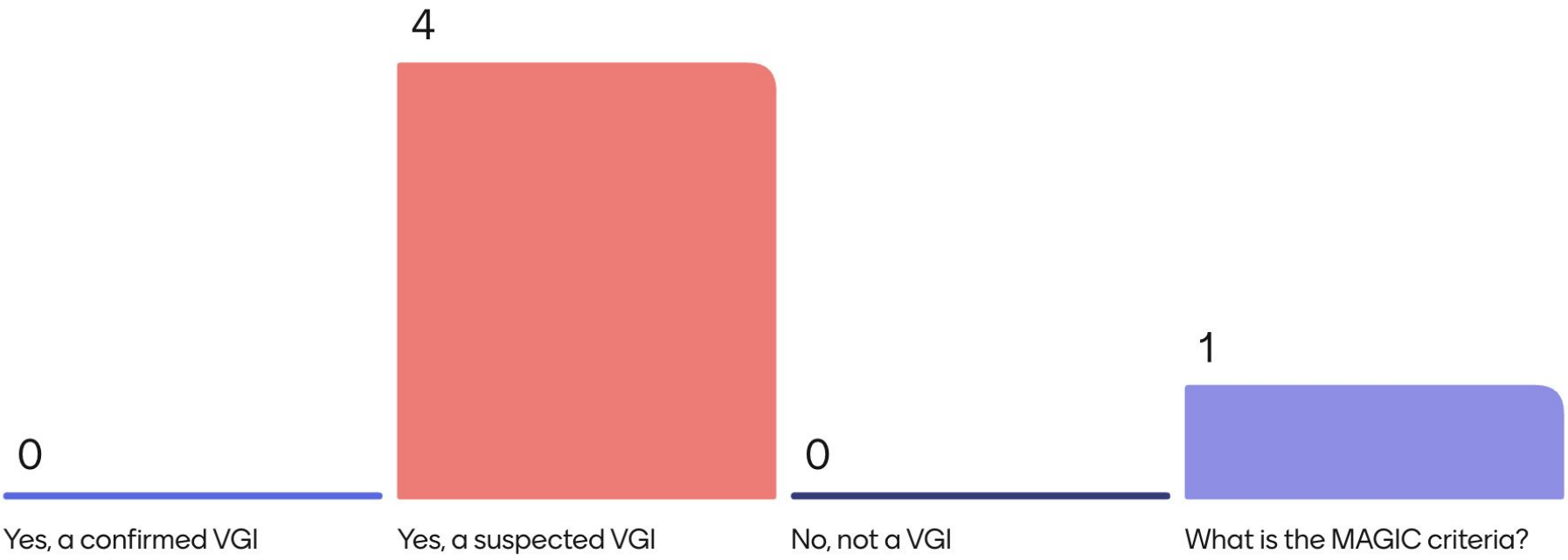
✨**MAGIC**✨
Management of Aortic Graft Infection Collaboration 🪄

[Q1] Is this a vascular graft infection?

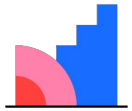


Mentimeter

[Q1] Per the MAGIC criteria, is this a vascular graft infection (VGI)?

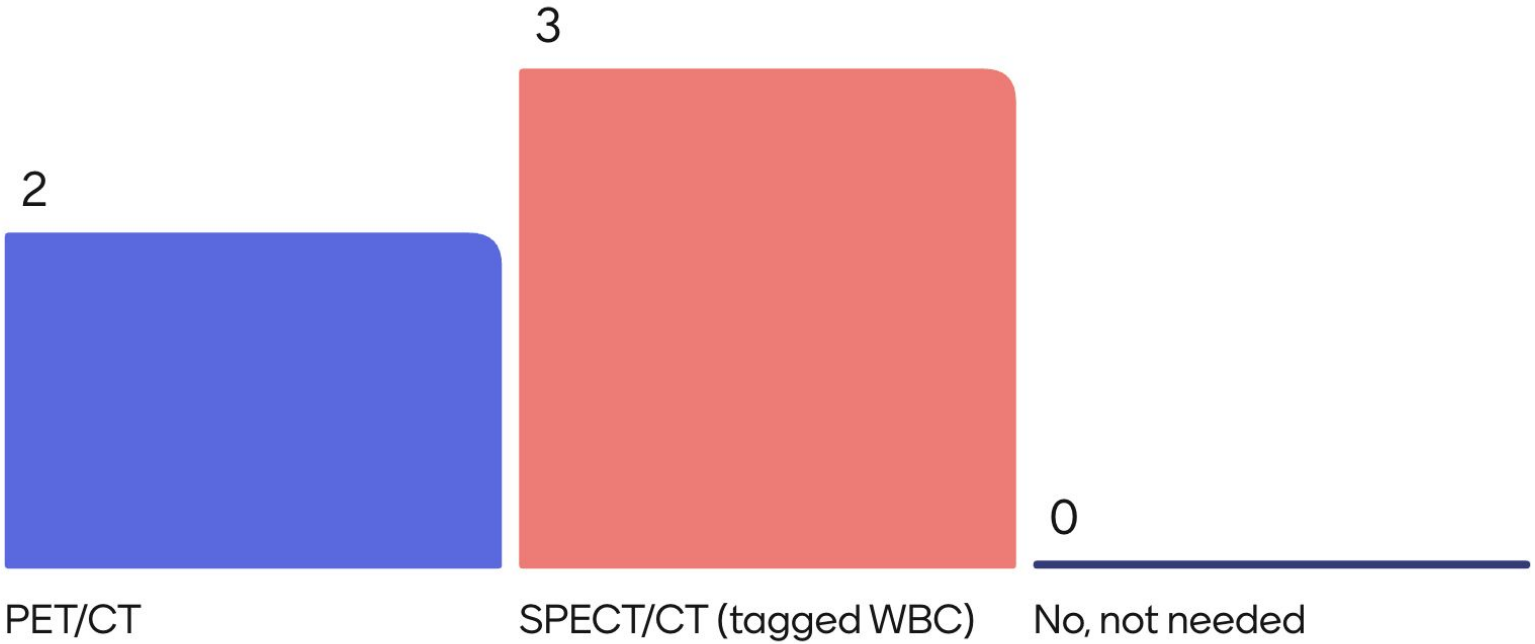


[Q2] Utility of PET/CT or SPECT?

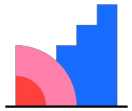


Mentimeter

[Q2] Would you order nuclear imaging?



[Q3] Chance of relapse w/o suppression



Mentimeter

[Q3] **What is the chance of relapse if...**

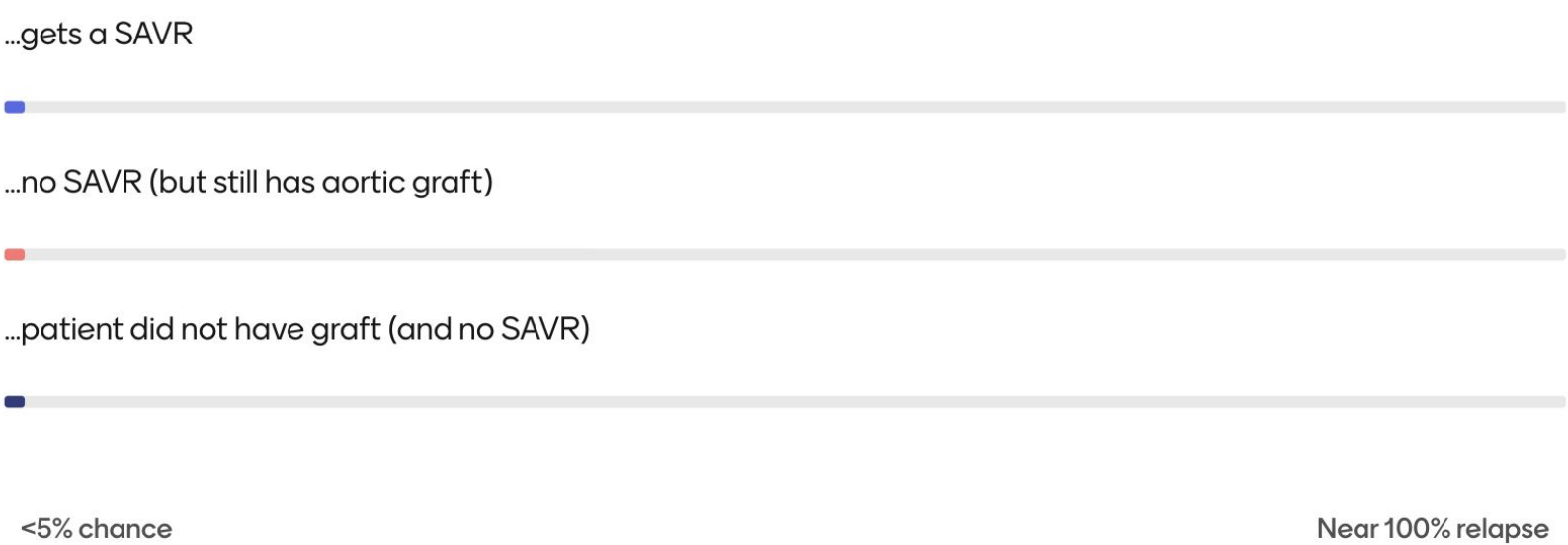


Table 1. A Case Definition for Vascular Graft Infection of the Management of Aortic Graft Infection Collaboration (MAGIC)

	Clinical/Surgical	Radiography	Laboratory[a]
Major criteria	1. Purulence (confirmed by microscopy) around graft or in aneurysm sac during surgery[b] 2. Open wound with exposed graft or communicating sinus tract 3. Fistula development (eg, aortoenteric) 4. Graft insertion in an infected site (eg, fistula, mycotic aneurysm, or infected pseudoaneurysm)	1. Perigraft fluid on CT scan ≥3 mo after insertion 2. Perigraft gas on CT scan ≥7 wk after insertion 3. An increase in perigraft gas volume demonstrated on serial imaging	1. Organisms recovered from an explanted graft 2. Organisms recovered from an intraoperative specimen 3. Organism recovered from a percutaneous aspirate of perigraft fluid

✨MAGIC✨
Management of Aortic Graft Infection Collaboration 🪄

Prior presentation (Oct'24)
https://www.hunterratliff1.com/talk/cid-2024-10-03/

Table 1. A Case Definition for Vascular Graft Infection of the Management of Aortic Graft Infection Collaboration (MAGIC)

	Clinical/Surgical	Radiography	Laboratory[a]
Major criteria	1. Purulence (confirmed by microscopy) around graft or in aneurysm sac during surgery[b] 2. Open wound with exposed graft or communicating sinus tract 3. Fistula development (eg, aortoenteric) 4. Graft insertion in an infected site (eg, fistula, mycotic aneurysm, or infected pseudoaneurysm)	1. Perigraft fluid on CT scan ≥3 mo after insertion 2. Perigraft gas on CT scan ≥7 wk after insertion 3. An increase in perigraft gas volume demonstrated on serial imaging	1. Organisms recovered from an explanted graft 2. Organisms recovered from an intraoperative specimen 3. Organism recovered from a percutaneous aspirate of perigraft fluid
Minor criteria	1. Localized clinical features of VGI (eg, erythema, warmth, swelling, purulent discharge, and pain) 2. Fever ≥38°C with VGI as most likely cause	1. Other (eg, suspicious perigraft gas/fluid/soft tissue inflammation; aneurysm expansion; pseudo-aneurysm formation; focal bowel wall thickening; discitis/osteomyelitis; suspicious metabolic activity on FDG PET/CT; radiolabeled leucocyte uptake)	1. Blood culture(s) positive and no apparent source except for VGI 2. Abnormally elevated inflammatory markers with VGI as the most likely cause (eg, ESR, CRP, and white blood cell count)

✨MAGIC✨
Management of Aortic Graft Infection Collaboration 🪄

Suspected VGI
~~One major~~ **– or –**
Minor from 2 of 3 categories

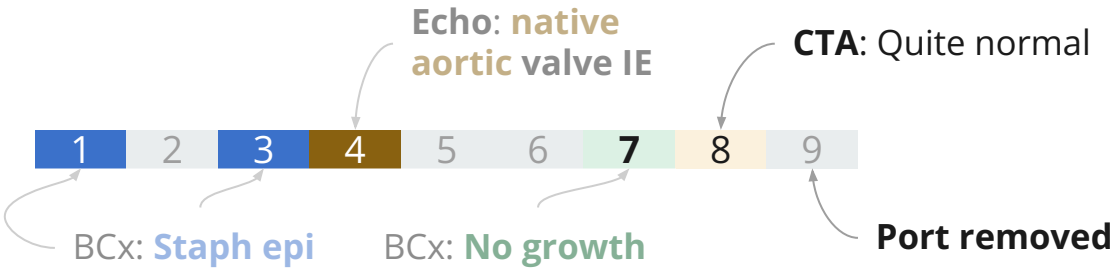
Confirmed VGI
~~One major~~ **– plus –** any other criterion (major or minor) from another category

Prior presentation (Oct'24)
https://www.hunterratliff1.com/talk/cid-2024-10-03/

Case 1: Hospital course

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**.

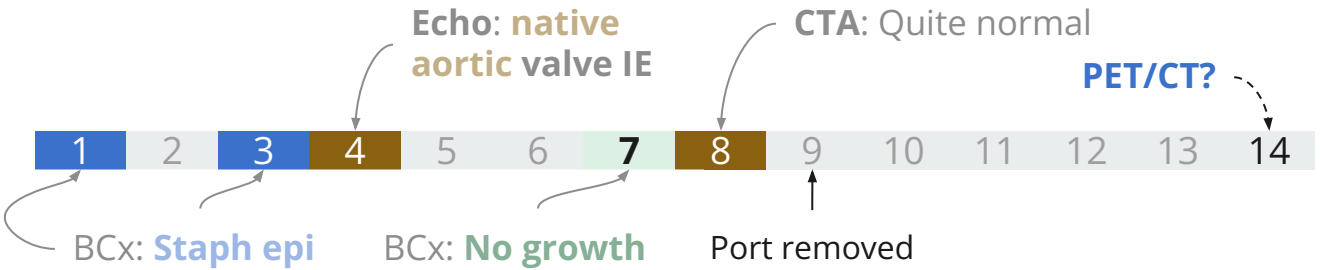
- **Vascular surgery consulted**: Not concerned for graft infection
- Port is removed



Case 1: Hospital course

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**. Clinical concern for VGI but CTA normal

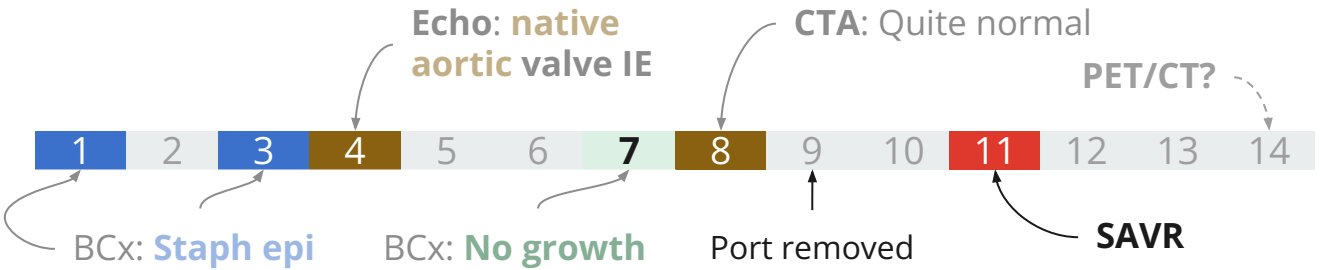
- Asked for **PET/CT or SPECT**...
  - Can't happen **until next week**



Case 1: Hospital course

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**. Clinical concern for VGI but CTA normal

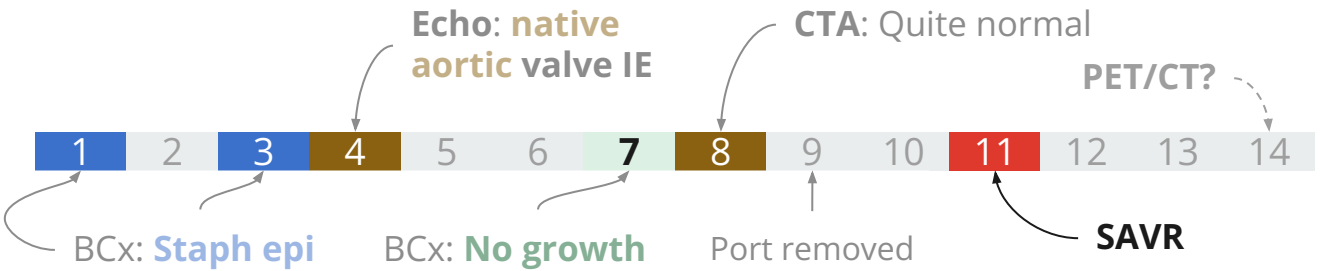
- Asked for **PET/CT or SPECT**...
  - Can't happen **until next week**
- CT surgery plans on **replacing aortic valve** before that time
  - Cardiogenic shock from aortic insufficiency is a **class I indication**



Case 1: Hospital course

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**. Clinical concern for VGI but CTA normal

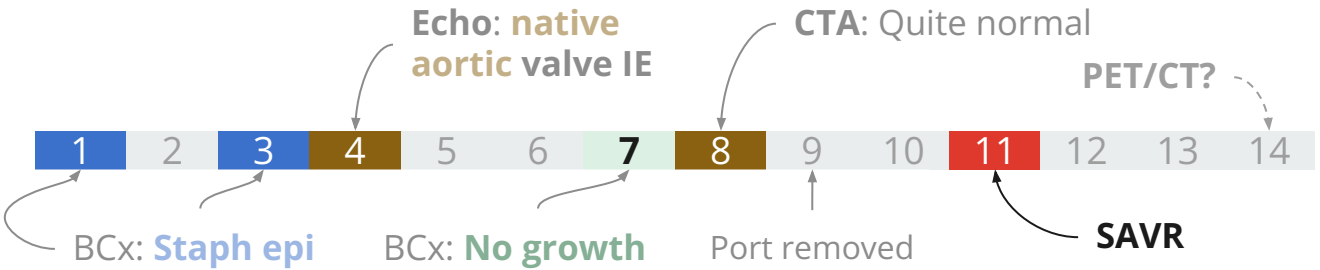
- Opted for **no nuclear imaging**
  - Would have been on 2 weeks on antibiotics at that point



Case 1: Hospital course

A **73 y/o M** with PMH including CLL (has port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**. Clinical concern for VGI but CTA normal

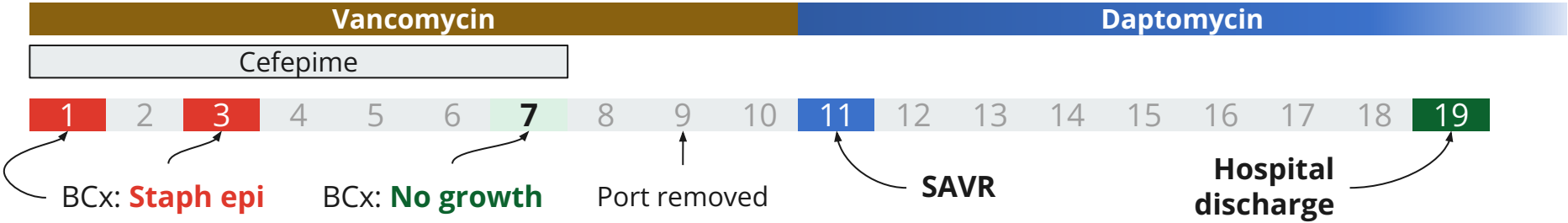
- Opted for **no nuclear imaging**
  - Would have been on 2 weeks on antibiotics at that point
- Had **surgical aortic valve replacement** with bioprosthetic valve
  - **Gram stain was positive**, but **no growth on cultures**
  - **Pathology** consistent with **acute endocarditis**



Case 1: Sign off

A **73 y/o M** with PMH including CLL (had port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native aortic** valve **staph epi endocarditis**. Clinical concern for VGI but CTA normal. s/p **SAVR** with pathology confirming bacterial endocarditis

- While awaiting daptomycin susceptibilities, continue **vancomycin**
  - If susceptible, transition to **daptomycin for 6 weeks from SAVR**
- Followed by **lifelong doxy suppression**



MARS is calling...

MARS #1: HPI

A **38 y/o M** with no PMH (he is in excellent health) p/w **two days** of a **painful vesicular rash** in the T12 distribution

MARS #1: HPI

A **38 y/o M** with no PMH (he is in excellent health) p/w **two days** of a **painful vesicular rash** in the T12 distribution

- Has been stressed recently with work (needing to **travel far from home**)
- Reportedly **received Shingrex booster** a few years ago
    - Which is kind of strange since he's immunocompetent

MARS #1: HPI

A **38 y/o M** with no PMH (he is in excellent health) p/w **two days** of a **painful vesicular rash** in the T12 distribution

- Has been stressed recently with work (needing to **travel far from home**)
- Reportedly **received Shingrex booster** a few years ago
  - Which is kind of strange since he's immunocompetent

Next steps?

- More questions?
- DDx?

Has been stressed recently with work (needing to **travel far from home**)

Image Credit: NASA/Joel Kowsky
April 1, 2026

MARS #1: Host changes in spaceflight [1]

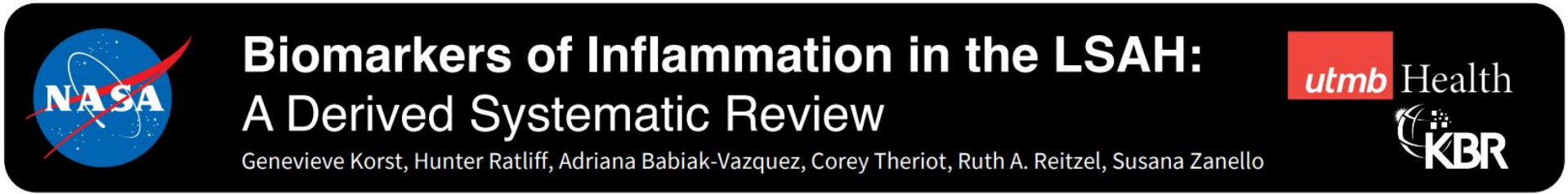
Don’t sue me

The “Mars/MARS” cases are hypothetical and any similarity to real persons are coincidental

I have no affiliation with NASA (but my wife did)

- I would be happy for that to change, if NASA needs a space-healthcare epidemiologist

Shout out to UTMB’s aerospace medicine residency



MARS #1: Host changes in spaceflight [1]

Spaceflight (zero gravity and other factors) do some **really weird stuff** to human physiology

- Most of these changes are non-infectious (but still really interesting)
- However, there are a fair amount of **immunologic changes** [self citation]

MARS #1: Host changes in spaceflight [1]

Spaceflight (zero gravity and other factors) do some **really weird stuff** to human physiology

- Most of these changes are non-infectious (but still really interesting)
- However, there are a fair amount of **immunologic changes** [self citation]

Spaceflight itself **causes immunocompromise**

- Which is why astronauts get the Shingrex vaccine [2]

MARS: Host immunosuppression in spaceflight [1]

Spaceflight makes you immunocompromised

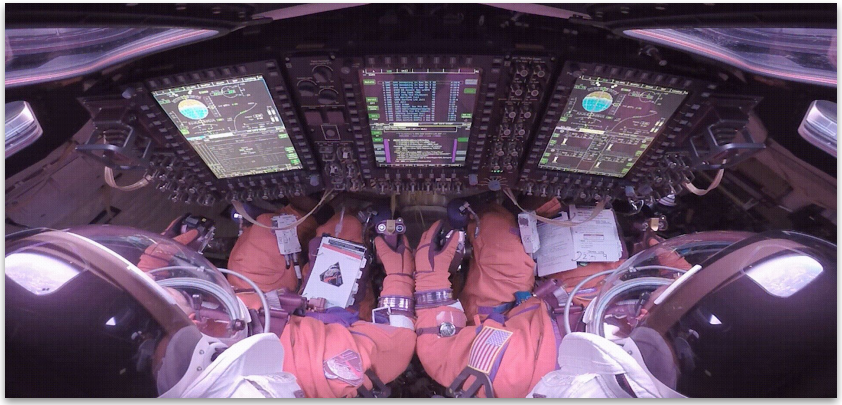
- **26 instances of infections** during the Space Shuttle program (STS-1 to STS-89; from 1989-98)
- More recently, **14 out of 17** astronauts had **reactivation of herpesviruses** (during short duration, LEO flights, or on return)

LEO = Low earth orbit

MARS: Host immunosuppression in spaceflight [1]

How?

- **Reversible hypoplasia** of lymph tissue (spleen & thymus)
- **Blunted mitogen response** of T lymphocytes (compared to terrestrial controls)
- Animal models show **widespread effects** on both **innate** and **humoral** immune response
- Seems to be **time limited** (but we haven't done years long missions, like to Mars)



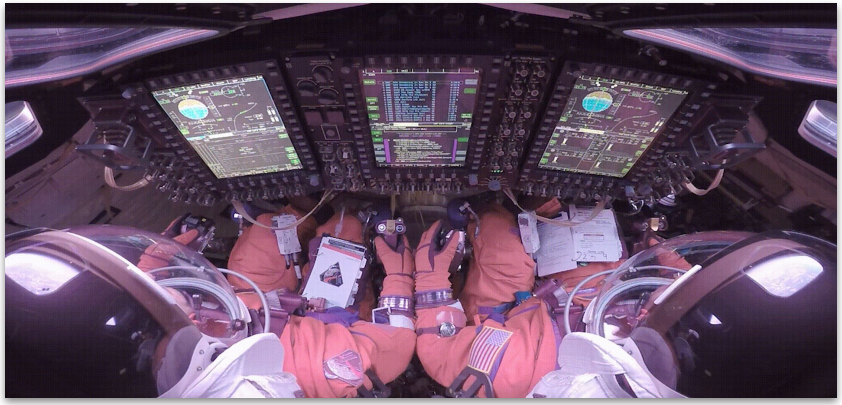
MARS: Host immunosuppression in spaceflight [1]

How?

- **Reversible hypoplasia** of lymph tissue (spleen & thymus)
- **Blunted mitogen response** of T lymphocytes (compared to terrestrial controls)
- Animal models show **widespread effects** on both **innate** and **humoral** immune response
- Seems to be **time limited** (but we haven't done years long missions, like to Mars)

Why?

- **Gravity** (lymphatic drainage) may play a role
- Might also be **psych response** (similar issues seen with longterm submarines or antarctica)

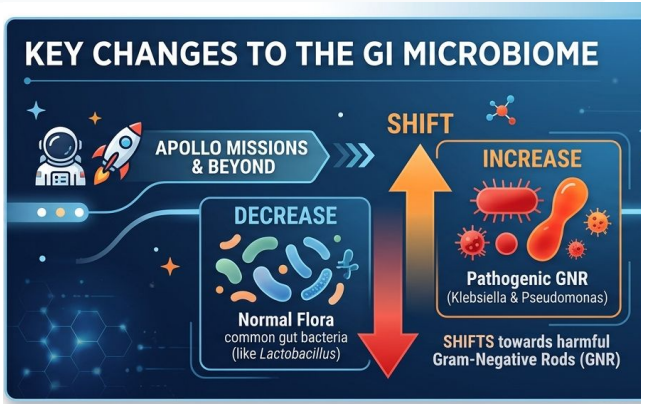


MARS: GI microbiome shift [1]

During Apollo missions:

- **Pathogenic increase:** Gram-negative rods (Klebsiella & Pseudomonas)
- **Loss of flora:** Significant shift away from normal healthy bacteria

Evidence from Soviet studies (Salyut & Mir) shows changes as early as two weeks into flight.



MARS: GI microbiome shift [1]

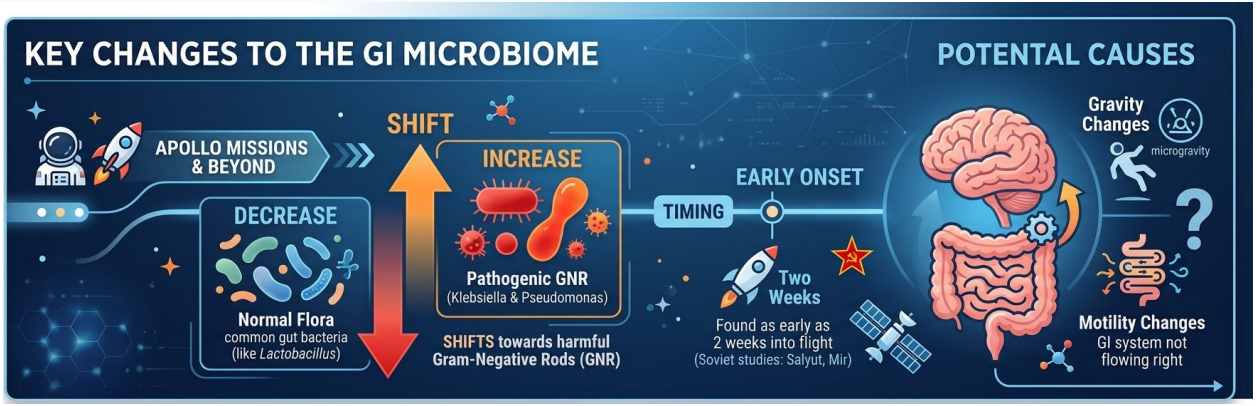
During Apollo missions:

- **Pathogenic increase:** Gram-negative rods (Klebsiella & Pseudomonas)
- **Loss of flora:** Significant shift away from normal healthy bacteria

Evidence from Soviet studies (Salyut & Mir) shows changes as early as two weeks into flight.

Potential Causes

- **Altered Gravity:** Microgravity impacts fluid distribution
- **Motility Changes:** GI system "not flowing right" in space environment



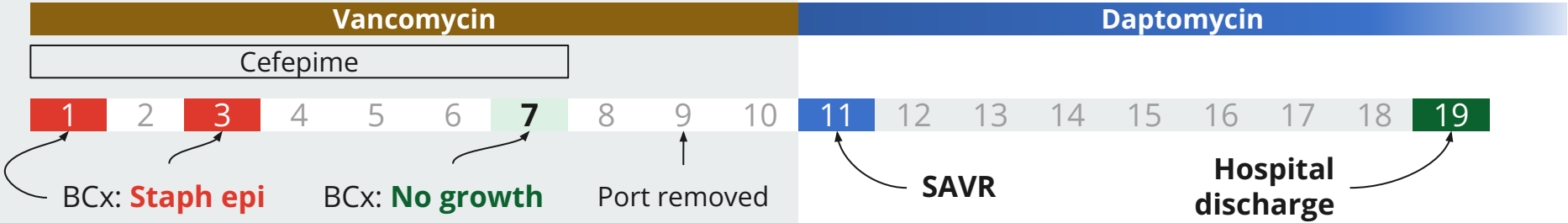
Returning to Earth (Case #1)

Artemis II landing
Image Credit: NASA/Joel Kowsky

Case 1: Summary of inpatient

A **73 y/o M** with PMH including CLL (had port), CAD/PAD s/p EVAR, OSA, seizures p/w **cardiogenic shock** & **native** **aortic** valve **staph epi endocarditis**. Clinical concern for VGI but CTA normal

- s/p **SAVR** with pathology confirming bacterial endocarditis
- Treated with **vanco** → **dapto**
- Plan for lifelong **doxy**



Case 1: Eosinophilia

At the time of the **initial** **consult**, patient already had **noticeable eosinophilia**

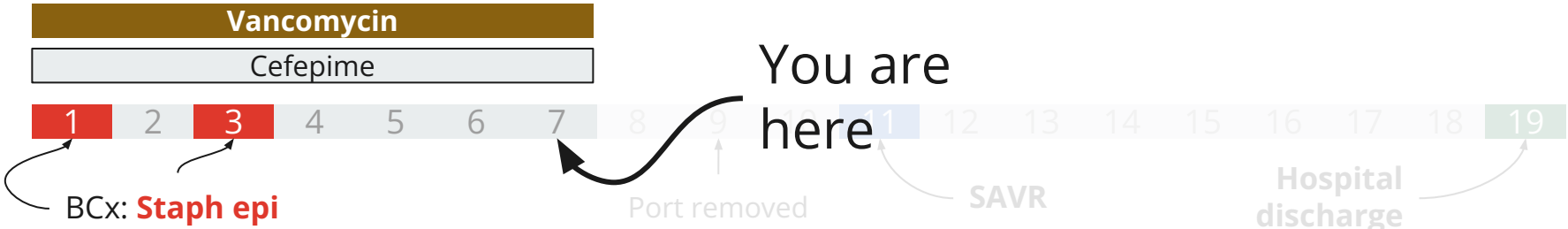
ABS COUNT	
PMN ABS	17.23 ▲
LYMPHS ABS	0.82 ▼
EOS ABS	0.87 ▲
MONOS ABS	1.72 ▲
BASOS ABS	0.17

Case 1: Eosinophilia

At the time of the **initial consult**, patient already had **noticeable eosinophilia**

- Was on vancomycin and cefepime

ABS COUNT	
PMN ABS	17.23 ▲
LYMPHS ABS	0.82 ▼
EOS ABS	0.87 ▲
MONOS ABS	1.72 ▲
BASOS ABS	0.17

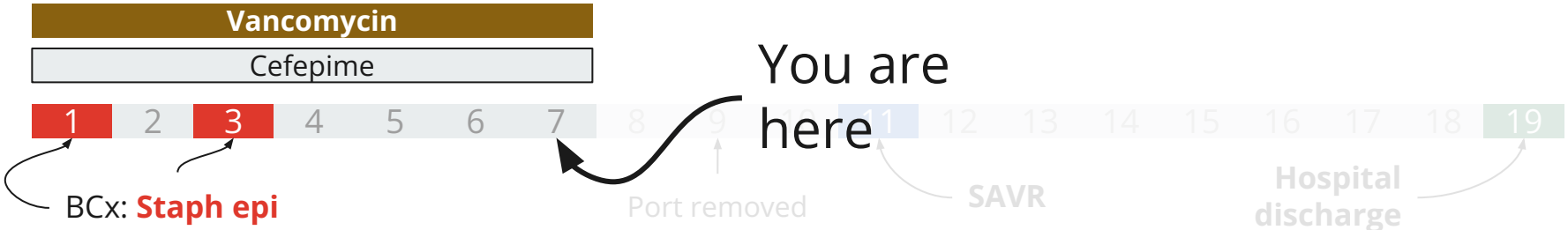


Case 1: Eosinophilia

At the time of the **initial** **consult**, patient already had **noticeable eosinophilia**

- Was on vancomycin and cefepime
- **No rash**
  - At least not yet...

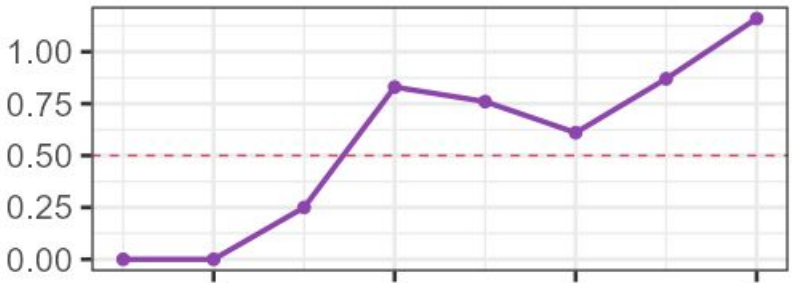
ABS COUNT	
PMN ABS	17.23 ▲
LYMPHS ABS	0.82 ▼
EOS ABS	0.87 ▲
MONOS ABS	1.72 ▲
BASOS ABS	0.17



Case 1: Eosinophilia

ABS COUNT	
PMN ABS	17.23 ▲
LYMPHS ABS	0.82 ▼
EOS ABS	0.87 ▲
MONOS ABS	1.72 ▲
BASOS ABS	0.17

Absolute eosinophil count

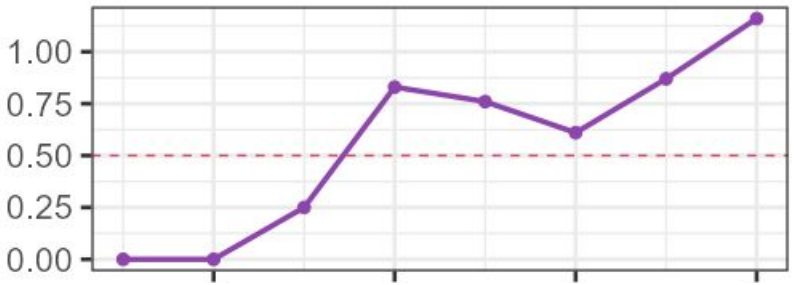


Upper limit of normal (500)

Case 1: Eosinophilia

Switched to **daptomycin**...

Absolute eosinophil count



Upper limit of normal (500)

1 2 **3** 4 5 **6** 7 8 **9** 10 11 **12** 13 14 **15** 16 17 **18** 19

Vancomycin | **Daptomycin**

Cefepime

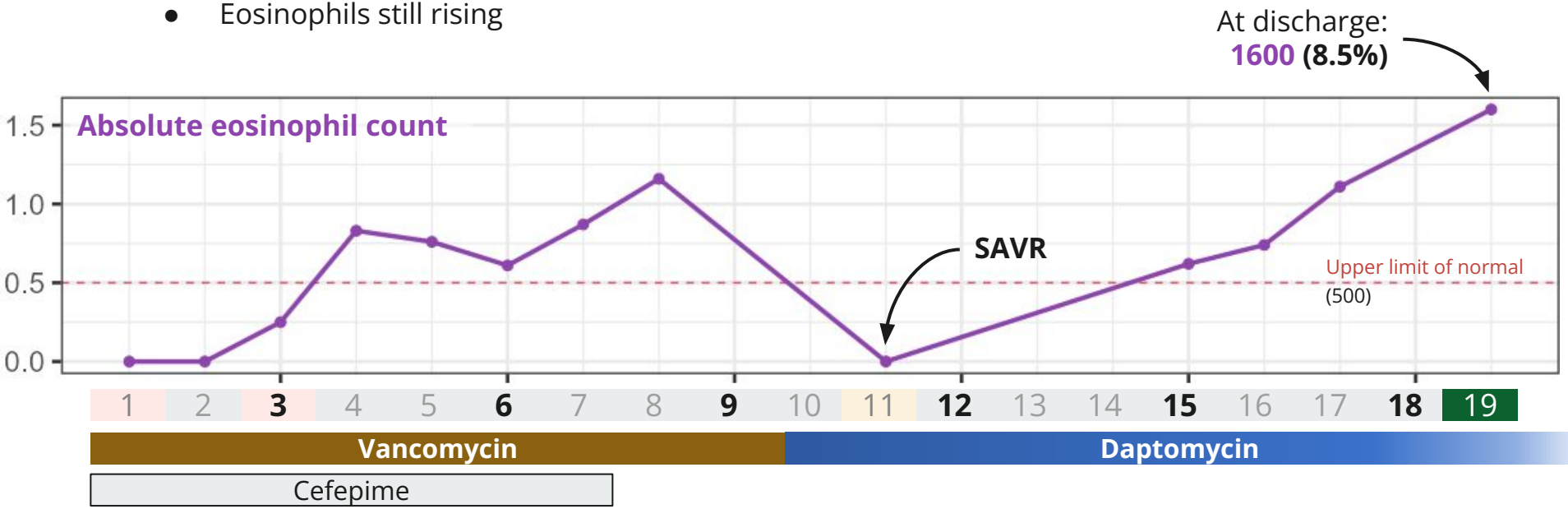
Case 1: Eosinophilia

Switched to **daptomycin**...with **no improvement** (perhaps worsened?)

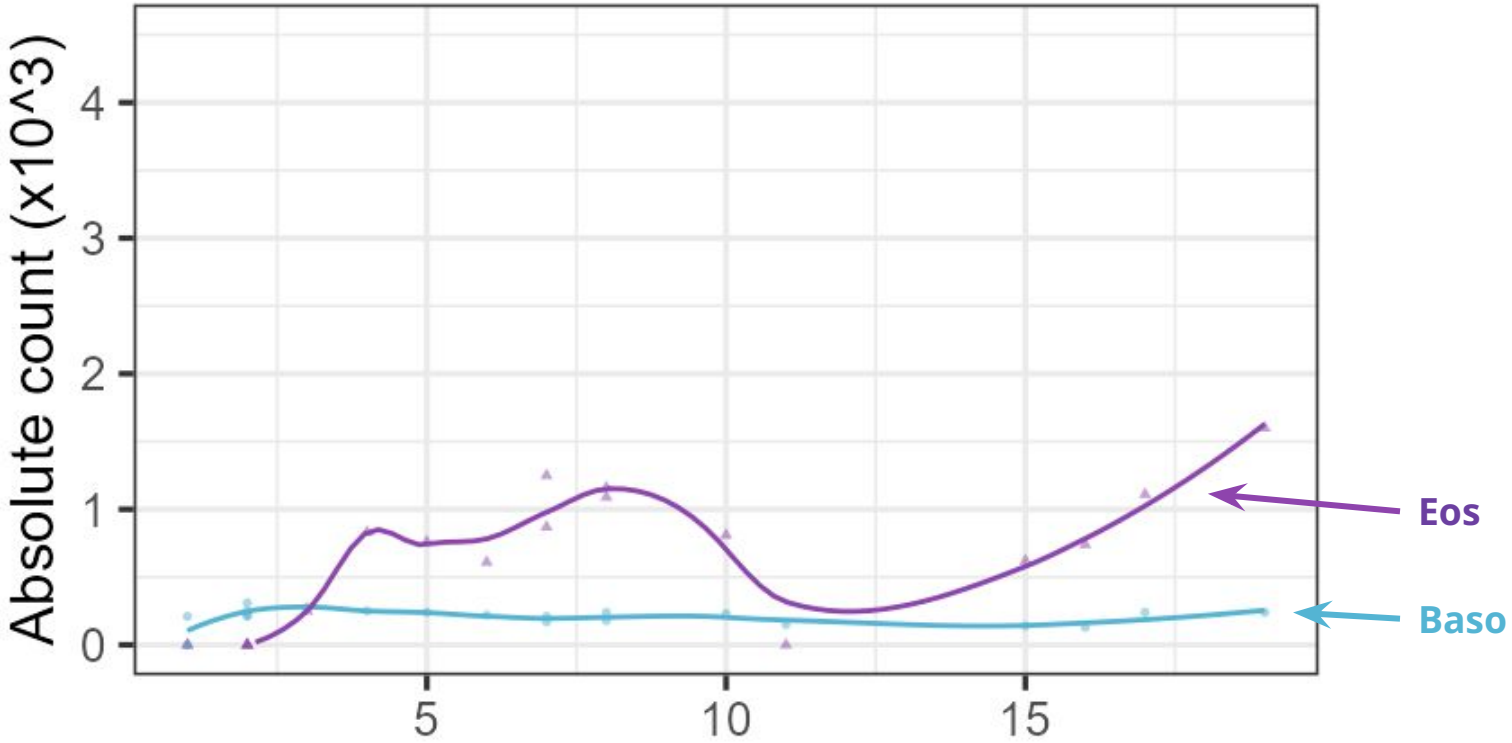
Case 1: Eosinophilia

Switched to **daptomycin**...with **no improvement** (perhaps worsened?)

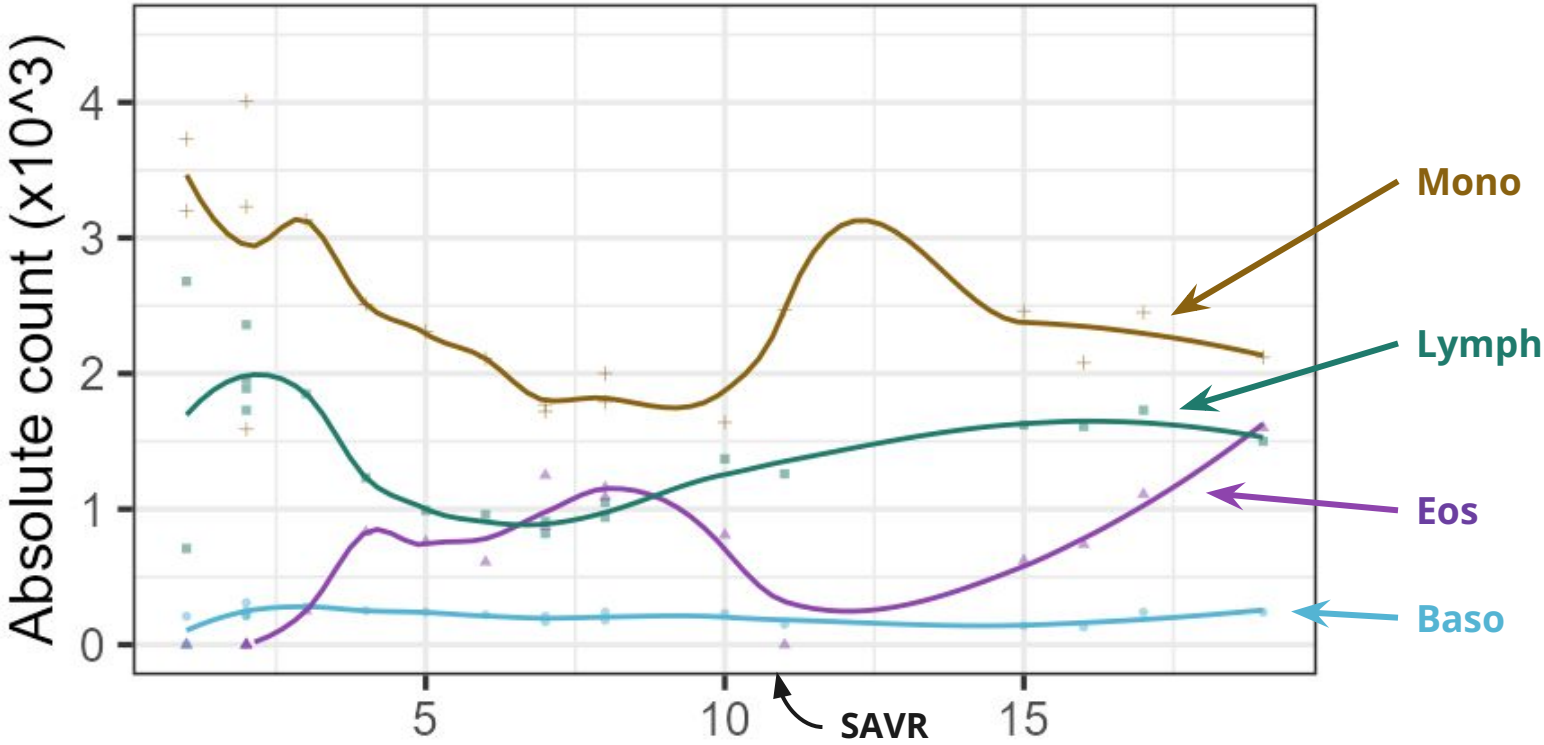
- Still asymptomatic
- Eosinophils still rising



Case 1: Full differential (w/o neutrophils)

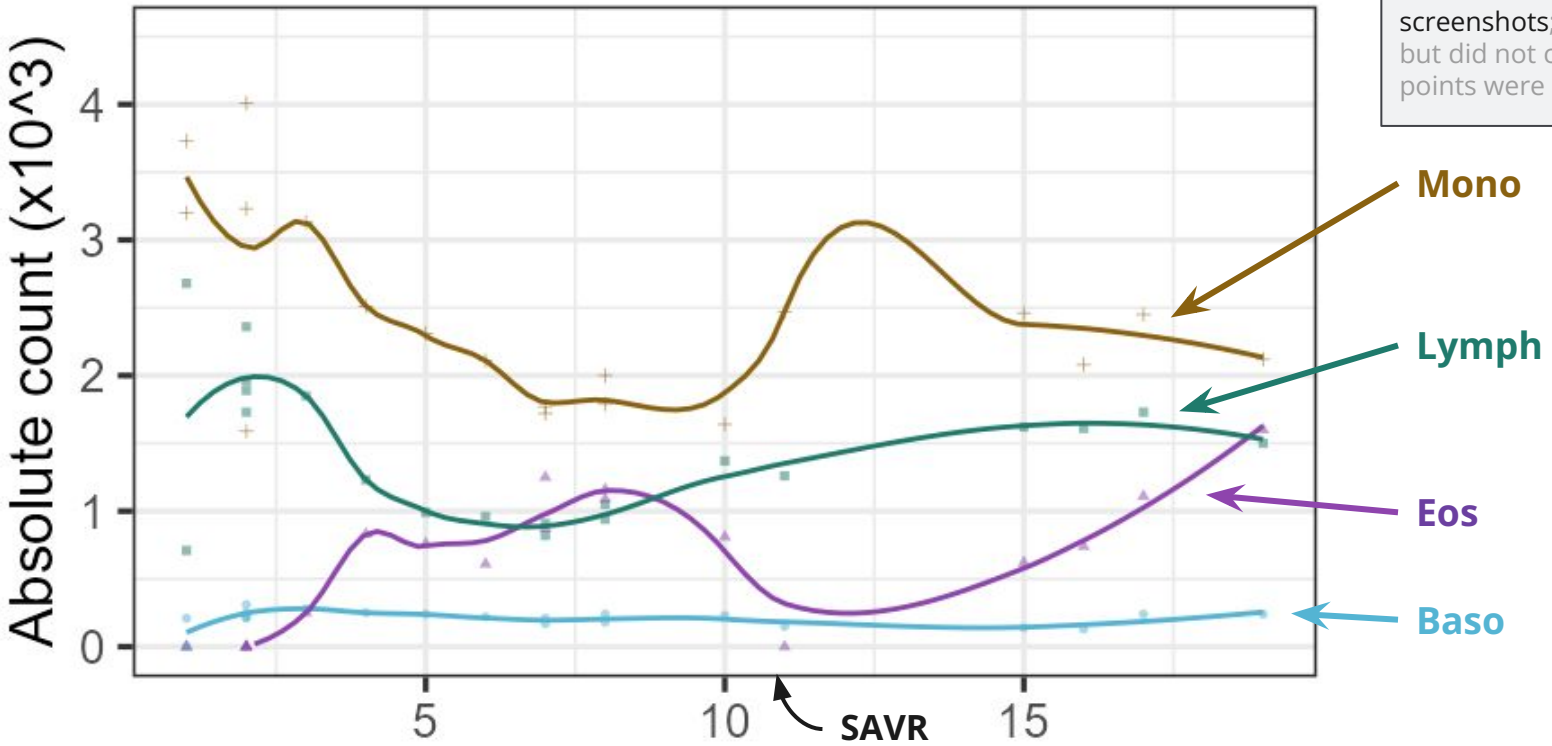


Case 1: Full differential (w/o neutrophils)



Case 1: Full differential (w/o neutrophils)

Disclosure
I used a local (non-cloud) from of AI to extract these numbers from screenshots; I spot checked them, but did not confirm all 1000 data points were read correctly



Case 1: OPAT

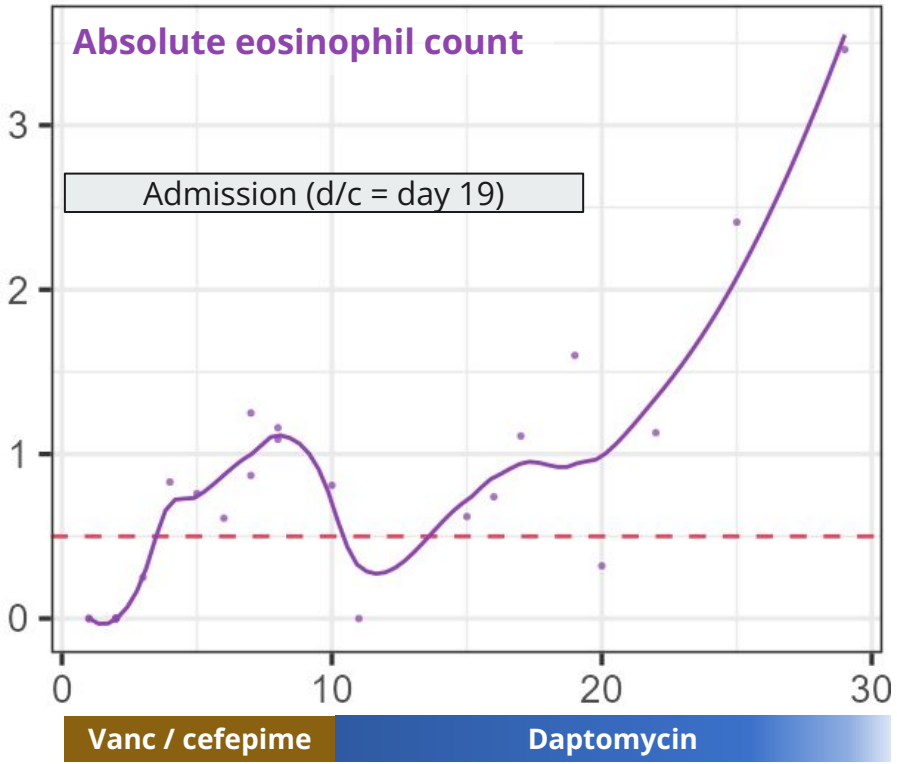
- Discharged to SNF
- Having nose bleeds (Brilinta)
- No other concerns (per staff at SNF)

Case 1: OPAT

- Discharged to SNF
- Having nose bleeds (Brilinta)
- No other concerns (per staff at SNF)

Those eosinophils **just keep on rising**

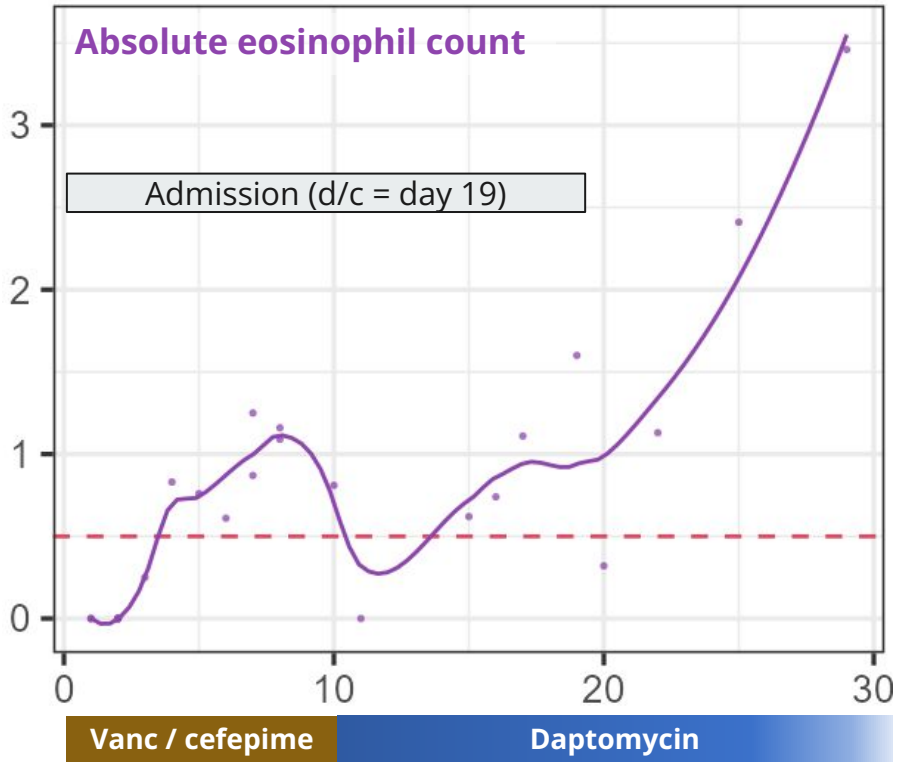
- Now at **3500**



Case 1: OPAT

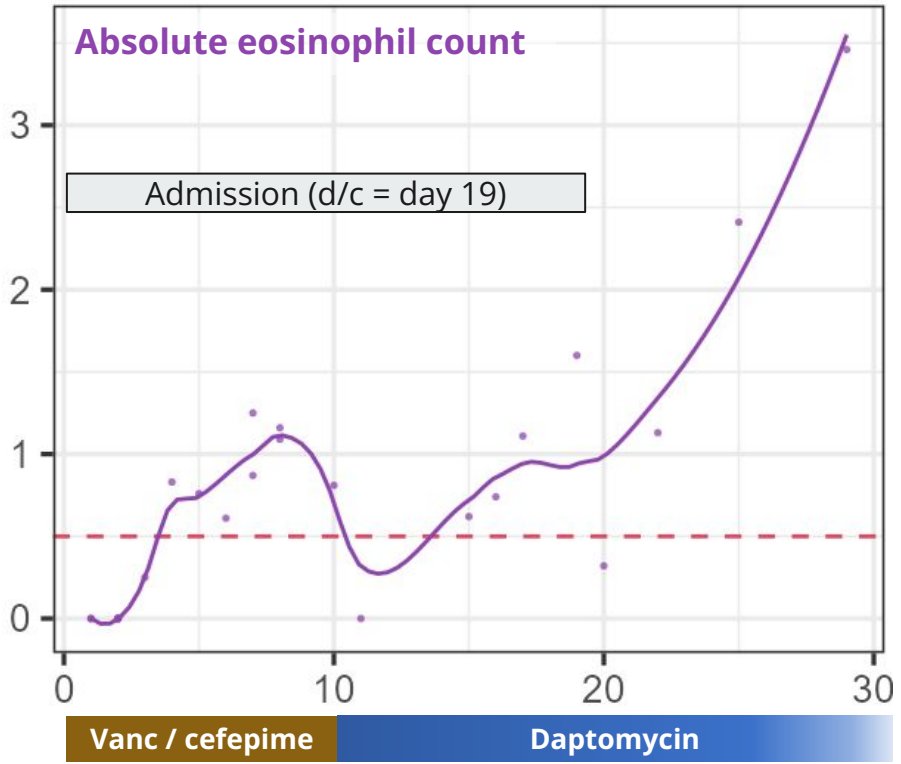
Labs	Day 17
WBC	20.6
Abs neut	14.9
Abs eos	1.1
CRP	35
AST	---
ALT	---
AlkPhos	---
Days since SAVR	7

Shortly before discharge



Case 1: OPAT

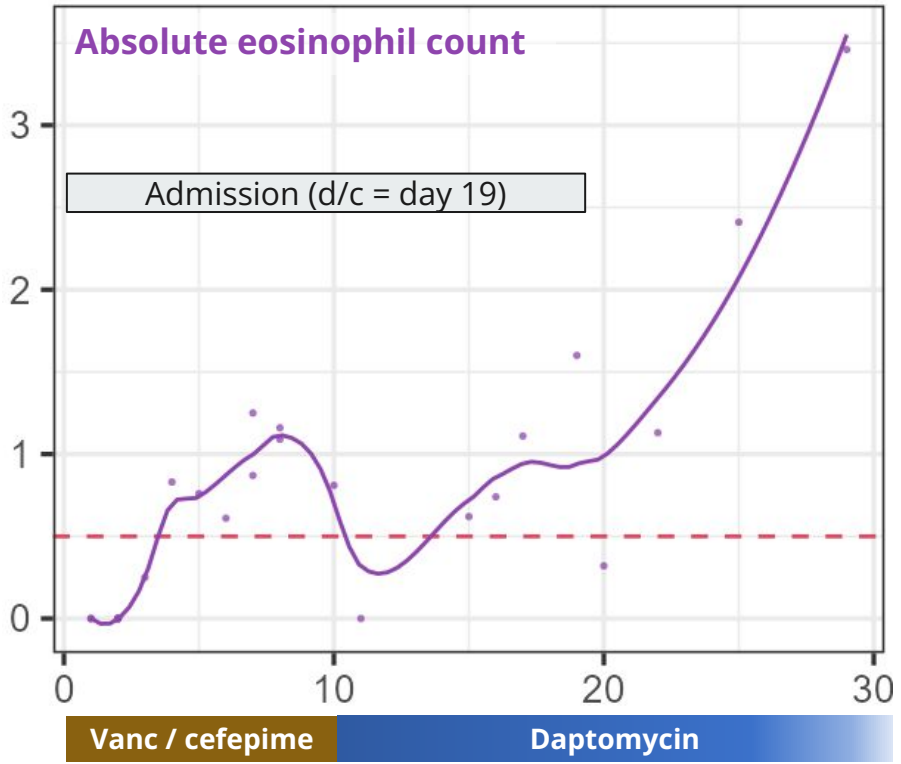
Labs	Day 17	D22	D25
WBC	20.6	18.9	17.7
Abs neut	14.9	15.5	11.6
Abs eos	1.1	1.2	**2.4**
CRP	35	32	---
AST	---	29	25
ALT	---	22	30
AlkPhos	---	71	**149**
Days since SAVR	7	12	15



Case 1: OPAT

ID clinic follow up

Labs	Day 17	D22	D25	D29
WBC	20.6	18.9	17.7	17.6
Abs neut	14.9	15.5	11.6	11.1
Abs eos	1.1	1.2	**2.4**	**3.5**
CRP	35	32	---	13
AST	---	29	25	**53**
ALT	---	22	30	**57**
AlkPhos	---	71	**149**	**188**
Days since SAVR	7	12	15	19

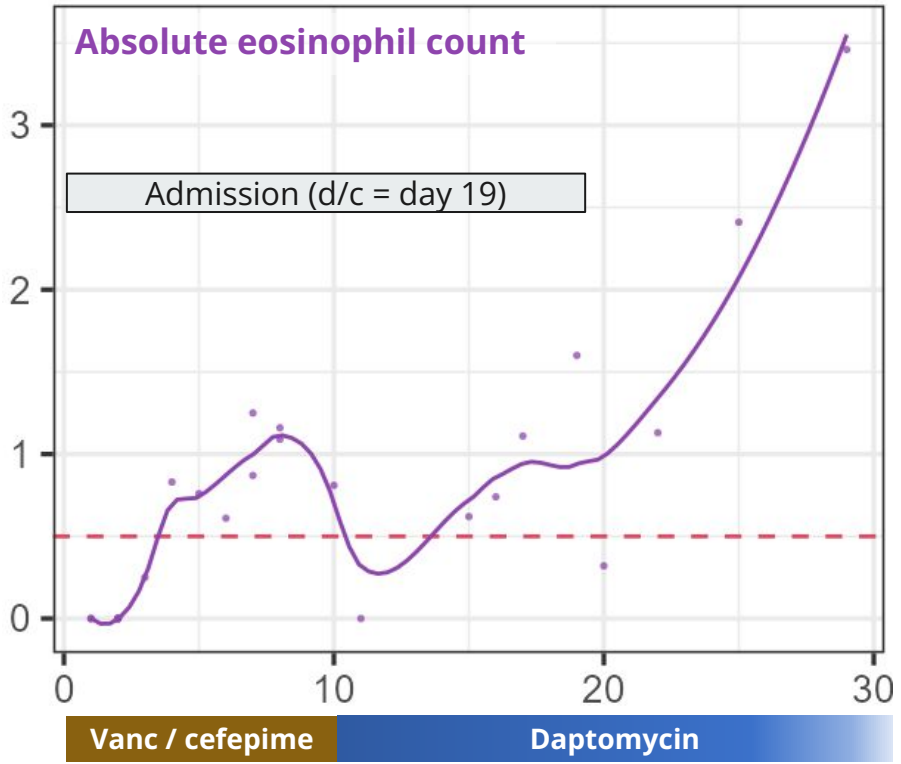


Case 1: OPAT

ID clinic follow up

Labs	Day 17	D22	D25	D29
WBC	20.6	18.9	17.7	17.6
Abs neut	14.9	15.5	11.6	11.1
Abs eos	1.1	1.2	**2.4**	**3.5**
CRP	35	32	---	13
AST	---	29	25	**53**
ALT	---	22	30	**57**
AlkPhos	---	71	**149**	**188**
Days since SAVR	7	12	15	19

- Normal platelets (200s-300s)
- Chem7 unremarkable
- CK normal (30s)

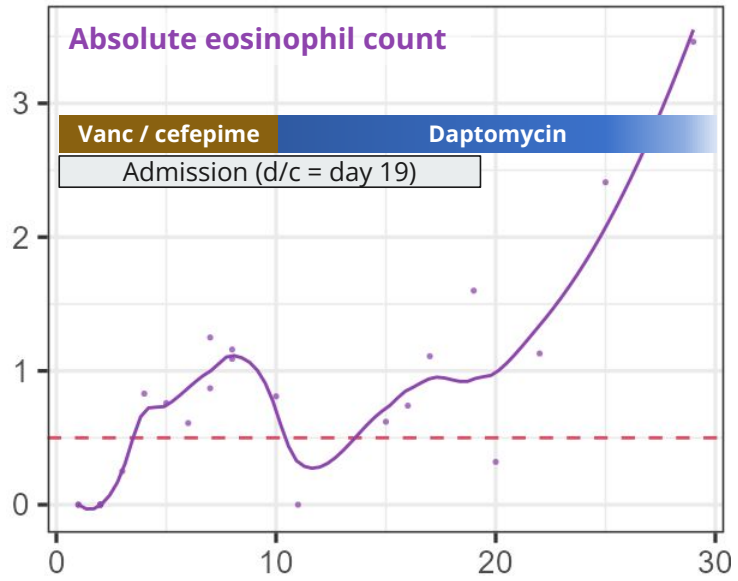


Case 1: Clinic follow up

A **73 y/o M** with PMH including **CLL** (had port), AAA w/ h/o EVAR, OSA, seizures p/w **native staph epi endocarditis** s/p **SAVR** (day 11). c/f VGI but CTA normal. Developing **profound eosinophilia**...

And **LFT problems**...

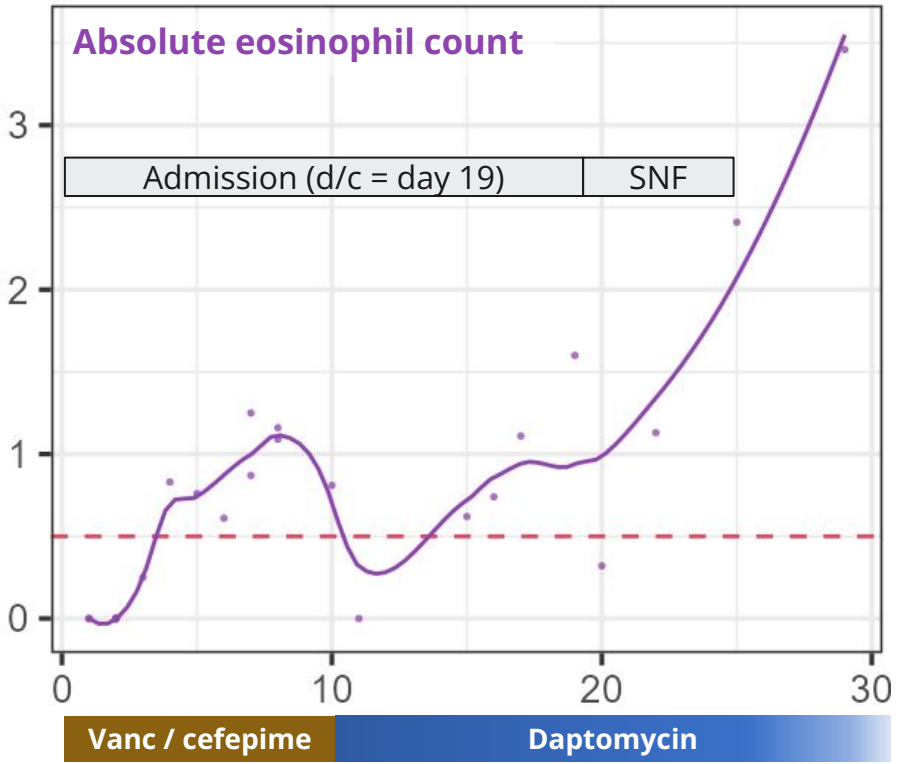
...time to ask about ~~**D**rug **R**eaction with **E**osinophilia and~~ **S**ystemic **S**ymptoms



Recent labs	Day 17	D22	D25	D29
WBC	20.6	18.9	17.7	17.6
Abs eos	1.1	1.2	**2.4**	**3.5**
CRP	35	32	---	13
AST	---	29	25	**53**
ALT	---	22	30	**57**
AlkPhos	---	71	**149**	**188**
Since SAVR	7	12	15	19

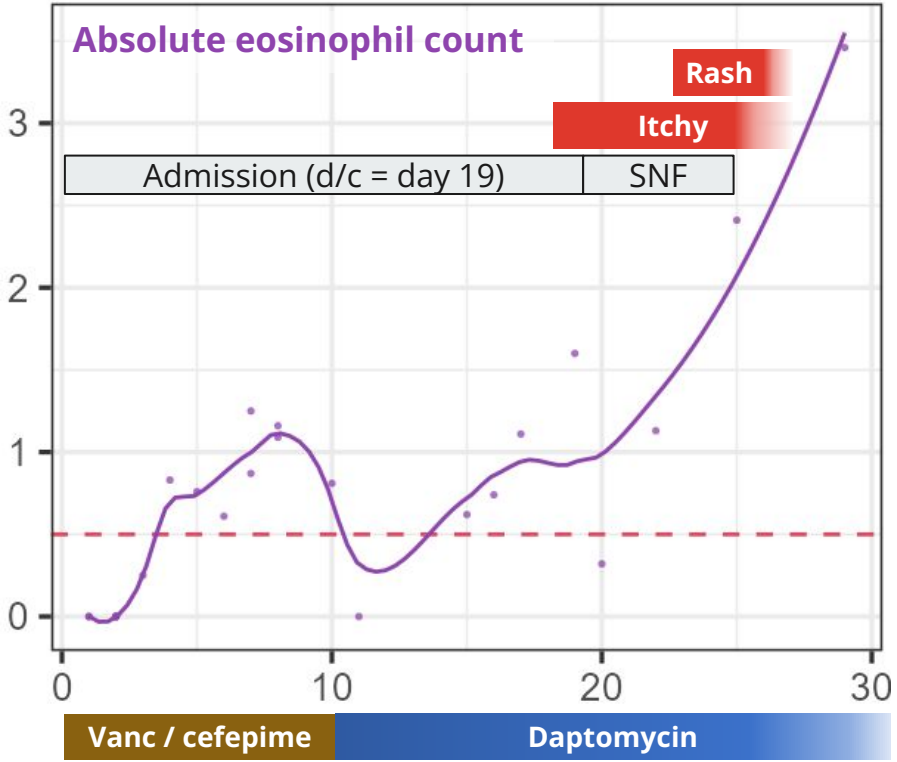
Case 1: ID clinic follow up

- His **breathing is fine**
  - Though one must assume there are some eosinophils in his lungs...
- His major concern is the nosebleeds



Case 1: ID clinic follow up

- His **breathing is fine**
  - Though one must assume there are some eosinophils in his lungs...
- His major concern is the nosebleeds
- But he has been having an **itchy rash**



Case 1: ID clinic follow up

He’s had **itchy rashes before** (more on this later), but **never been this severe** before

Case 1: ID clinic follow up

He's had **itchy rashes before** (more on this later), but **never been this severe** before

Case 1: ID clinic follow up

He's had **itchy rashes before** (more on this later), but **never been this severe** before

Zero improvement with:

- Topical steroid cream
- Benadryl

Case 1: ID clinic follow up

He's had **itchy rashes before** (more on this later), but **never been this severe** before

Zero improvement with:

- Topical steroid cream
- Benadryl

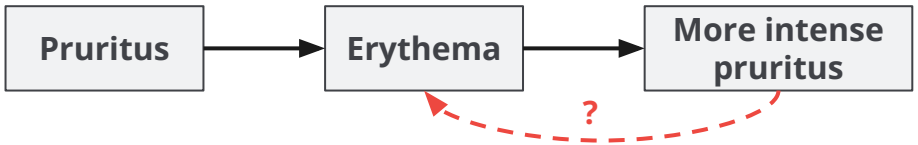
Rash before abx

Onset: Wife informs that he had a minor version of this same rash for maybe **a month before hospitalization**

- Started on **bilateral legs**
- Lesser extent in webs of fingers

Case 1: ID clinic follow up

He's had **itchy rashes before** (more on this later), but **never been this severe** before



Zero improvement with:

- Topical steroid cream
- Benadryl

Rash before abx

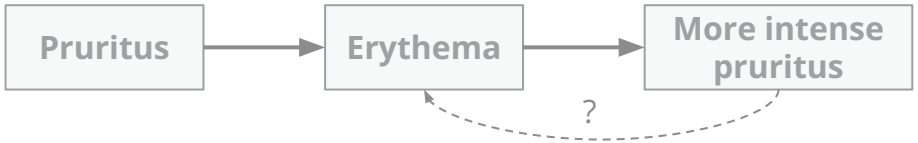
Onset: Wife informs that he had a minor version of this same rash for maybe **a month before hospitalization**

- Started on **bilateral legs**
- Lesser extent in webs of fingers

Improvement?

- During hospital stay, "rash" **did not spread** to new areas
- Patient thinks it's because he was **unable to itch himself**

Case 1: ID clinic follow up



Rash before abx

Onset: Wife informs that he had a <u>minor version</u> of this same rash for maybe **a month before hospitalization**

- Started on **bilateral legs**
- Lesser extent in webs of fingers

Improvement?

- During hospital stay, "rash" **did <u>not</u> spread** to new areas
- Patient thinks it's because he was **unable to itch himself**

Worsening (at SNF)

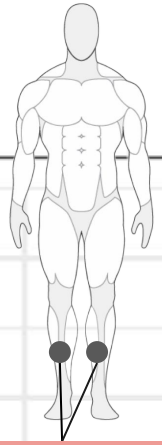
1. **New areas involved**:
   Abdomen → arms → face
2. **Old areas**:
   Still have "rash" but **not itchy**
3. **Severity**:
   Pruritis is **way more intense** than what he had prior to admission

Case 1: Rash timeline

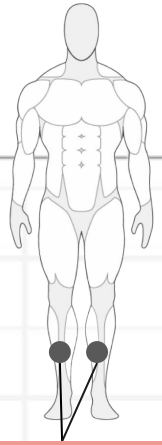
Rash before abx

Onset: Wife informs that he had a minor version of this same rash for maybe **a month before hospitalization**

- Started on **bilateral legs**
- Lesser extent in webs of fingers



Case 1: Rash timeline



Minor itchy rash

Not itchy rash

Absolute count (x10^3)

3

2

1

0

-20

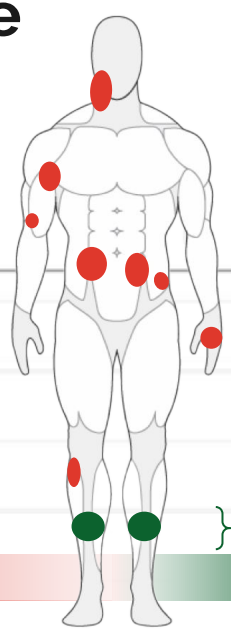
0

20

Case 1: Rash timeline

Worsening (at SNF)

1. New areas involved: Abdomen → arms → face
2. Old areas: **no longer itchy**
3. Severity: Pruritis is **way more intense**



Severe itch

Rash in new places

Minor itchy rash

Not itchy rash

Absolute count (x10^3)

3

2

1

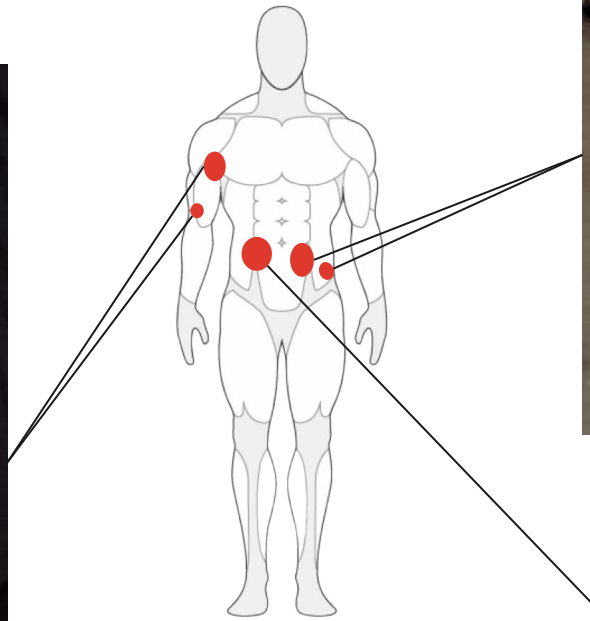
0

-20

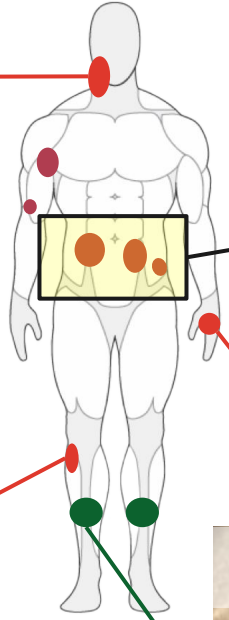
0

20

Case 1: Exam



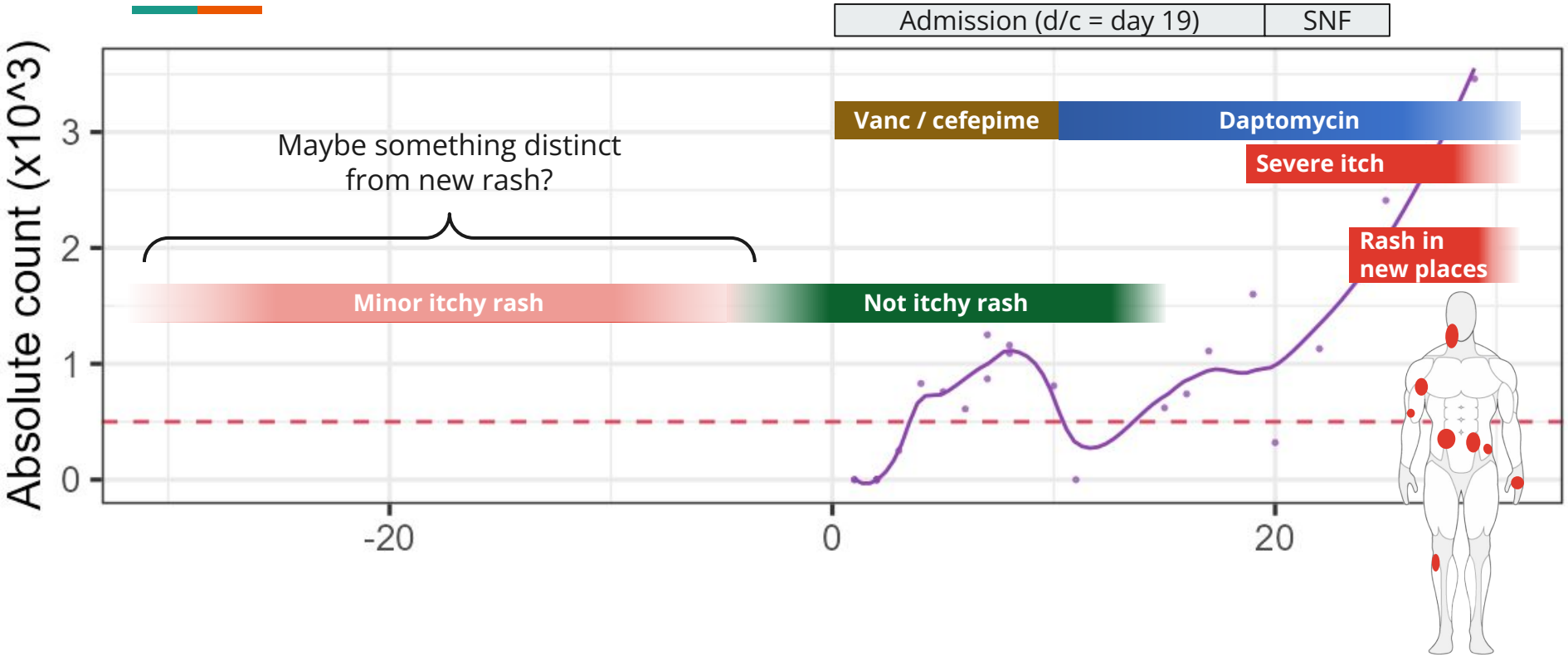
Blanching rashes



Not itchy

Not very itchy

Case 1: Rash timeline



Case 1: Social history, exposures, & risk factors

Geographic & Travel	• Lives on Ohio/WV border with wife of 35+ years • No recent travel, never out of the country

Case 1: Social history, exposures, & risk factors

Geographic & Travel	• Lives on Ohio/WV border with wife of 35+ years • No recent travel, never out of the country
Occupational	• No longer working • Doesn't spend much time outdoors anymore (**used to hunt**, but not as much in recent years; none this season)

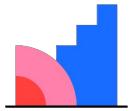
Case 1: Social history, exposures, & risk factors

Geographic & Travel	• Lives on Ohio/WV border with wife of 35+ years • No recent travel, never out of the country
Occupational	• No longer working • Doesn't spend much time outdoors anymore (**used to hunt**, but not as much in recent years; none this season)
Animals	• Denies farm animal exposures, bird/reptile exposures, or other animal exposure (aside from their pet dog)

Case 1: Social history, exposures, & risk factors

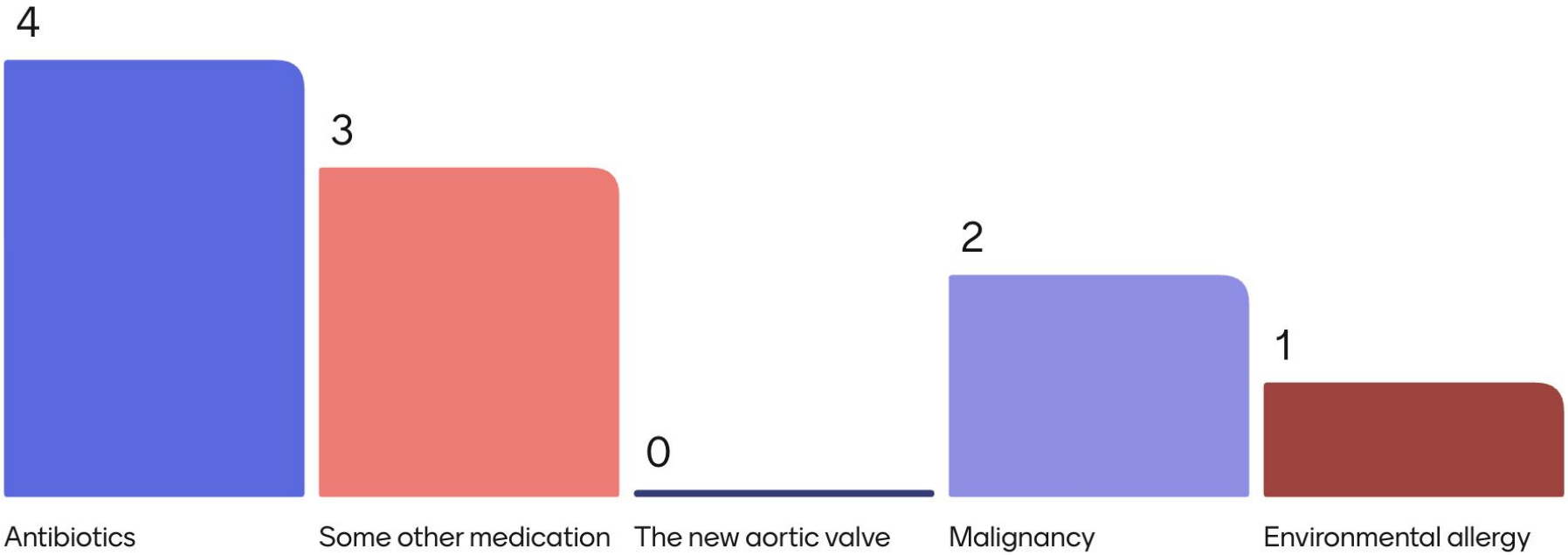
Geographic & Travel	• Lives on Ohio/WV border with wife of 35+ years • No recent travel, never out of the country
Occupational	• No longer working • Doesn't spend much time outdoors anymore (**used to hunt**, but not as much in recent years; none this season)
Animals	• Denies farm animal exposures, bird/reptile exposures, or other animal exposure (aside from their pet dog)
Medications	• Has been on Lamictal (seizures) and aspirin (CAD) for >8 years • Started on **Brilinta** on admission (~day 1) after had PCI • Started on **amio** (post-SAVR) for A-fib • Allergy: Bactrim causes rash, no issues with other antibiotics in the past

[Q4] What is causing the rash?



Mentimeter

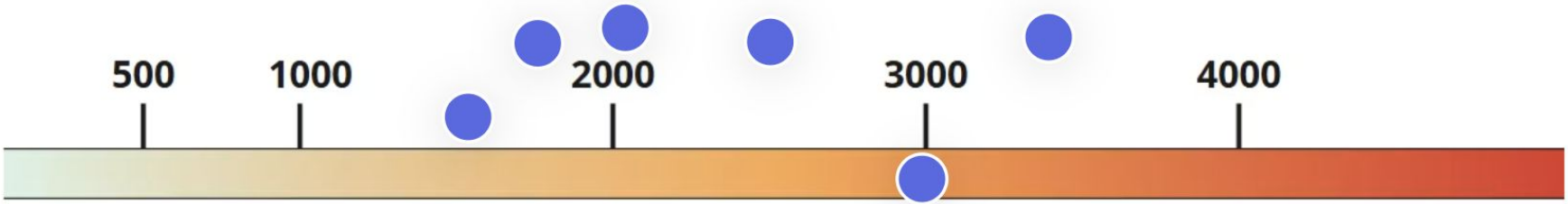
[Q4] What is causing the rash/eosinophilia?



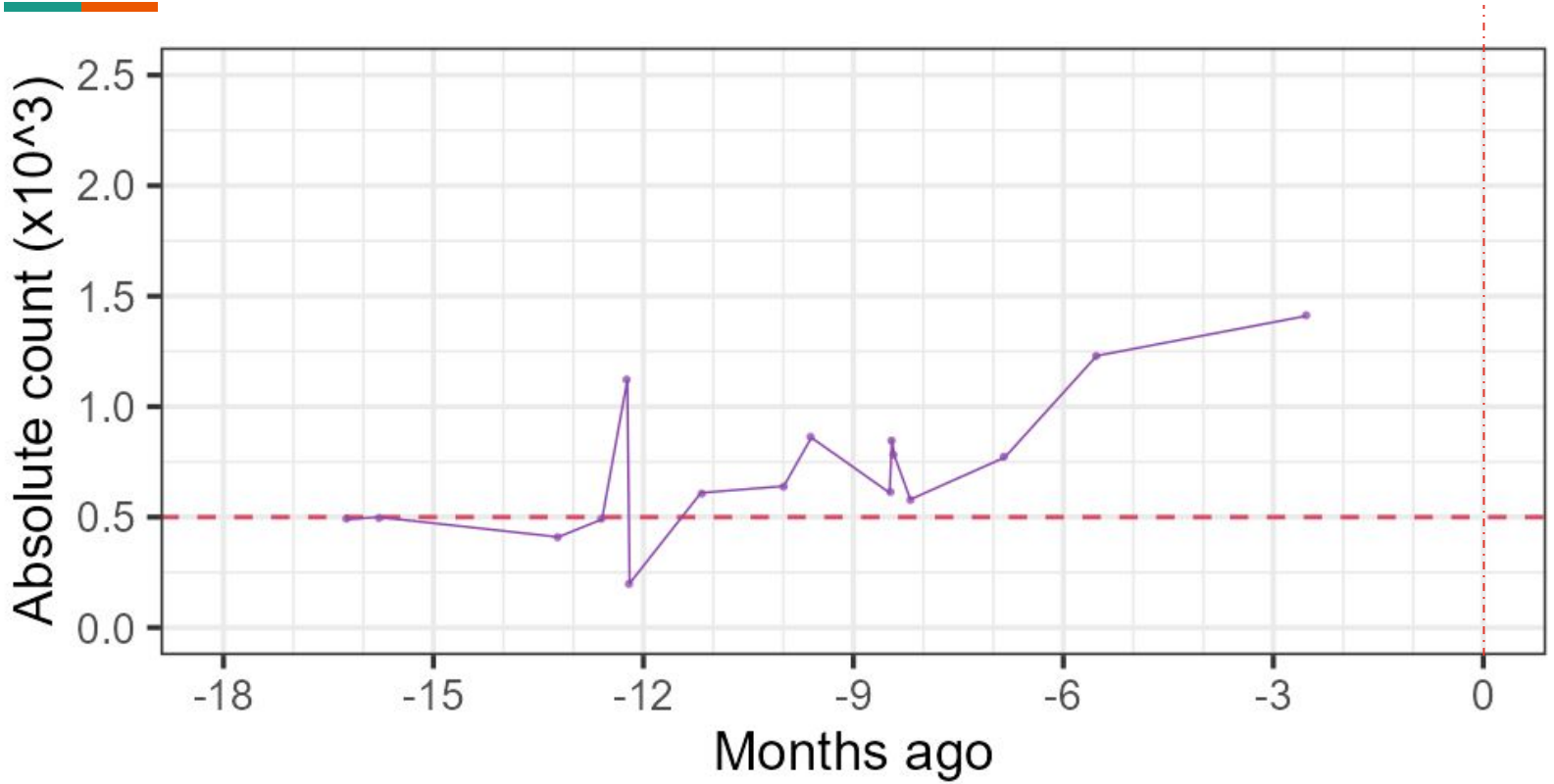
[Q5] Eosinophilia: How high is too high?

Assuming no symptoms

[Q5] At what eosinophil count would you change therapy?

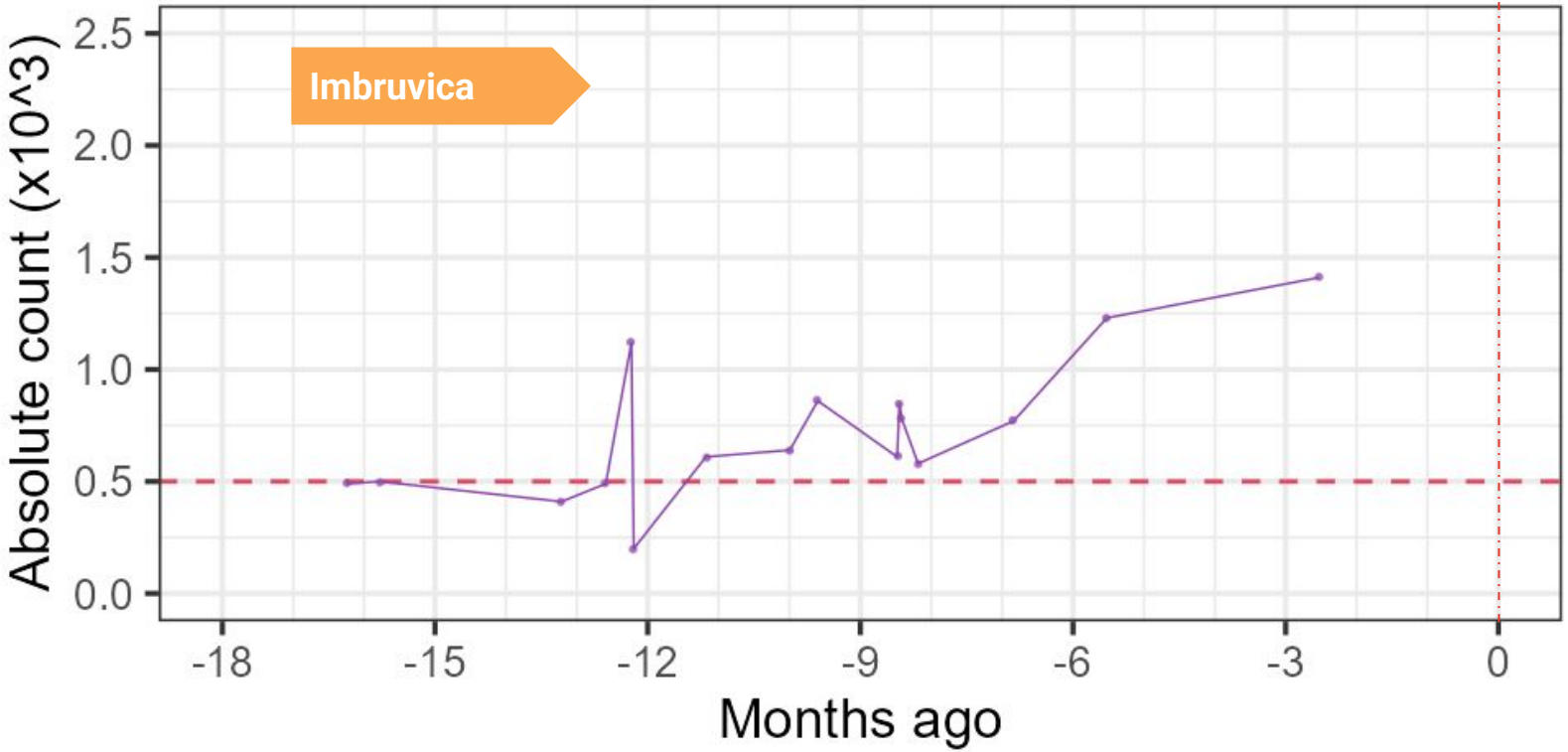


Case 1: Eosinophilia is not *exactly* new…

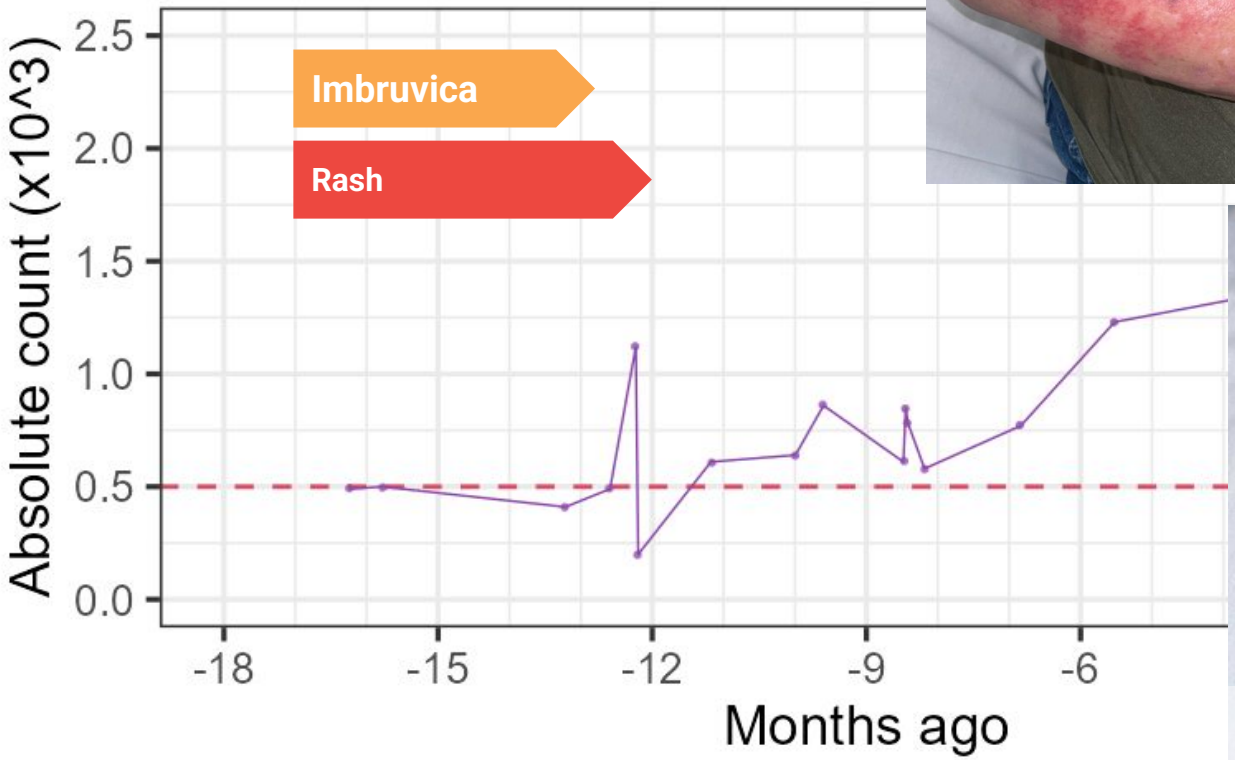


Imbruvica
(ibrutinib)

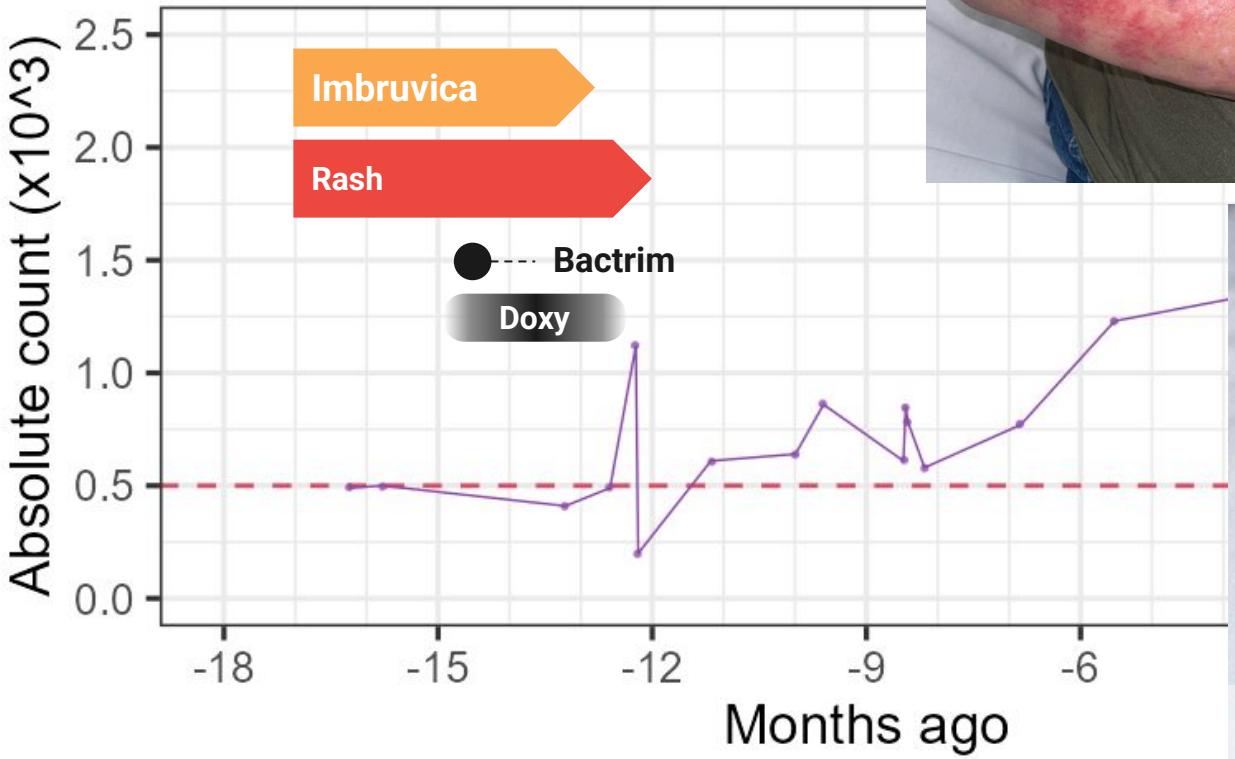
IE admission

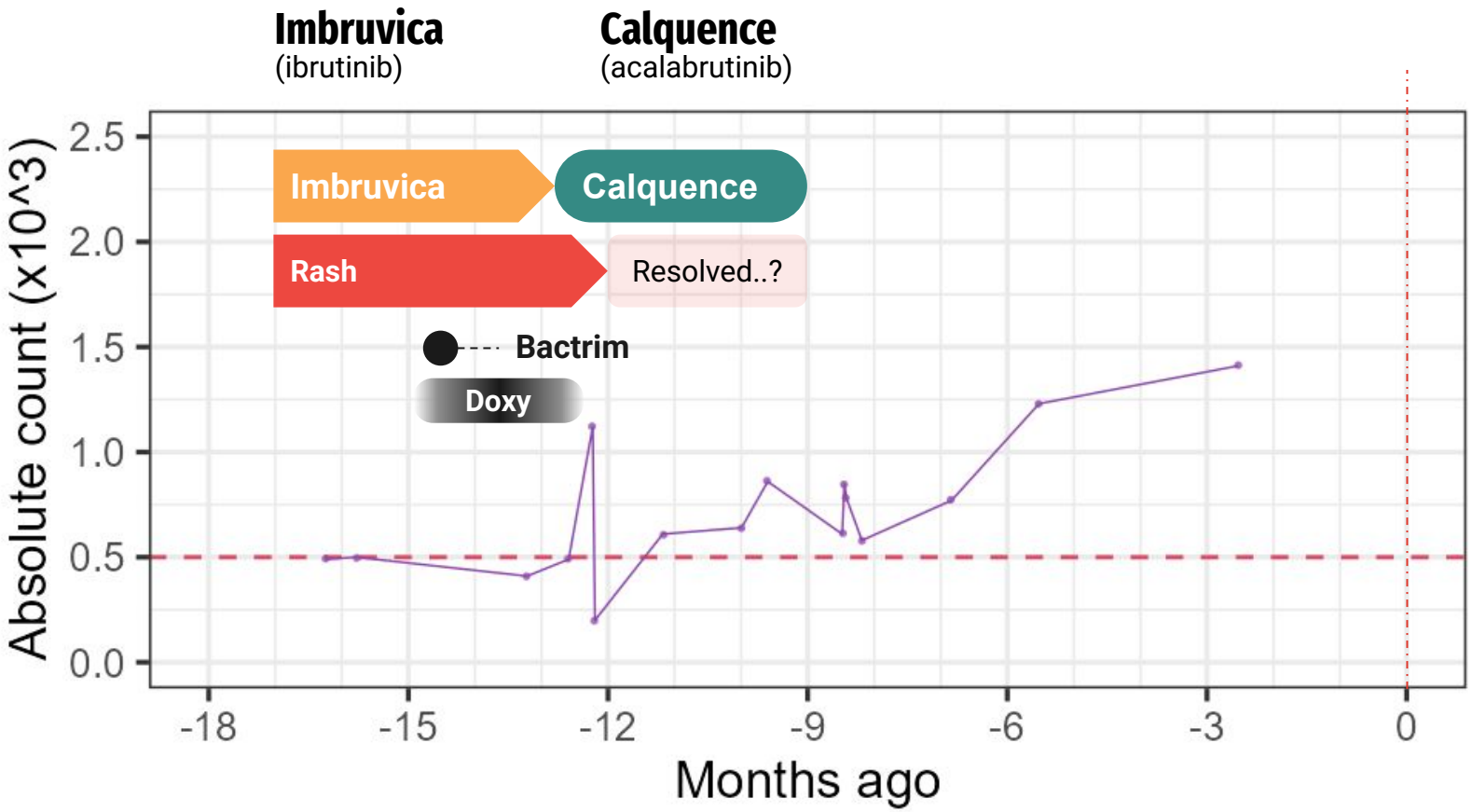


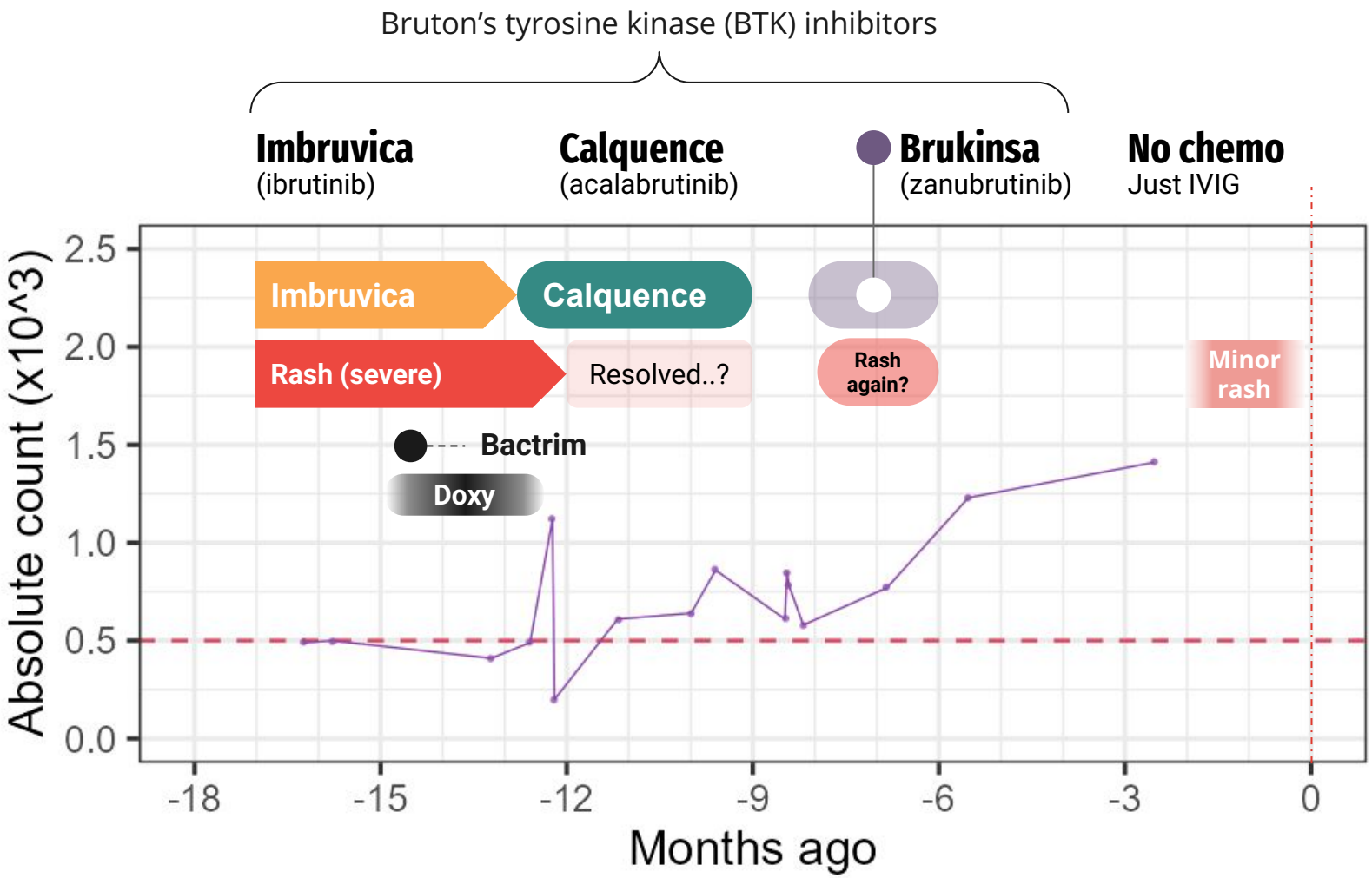
Imbruvica
(ibrutinib)

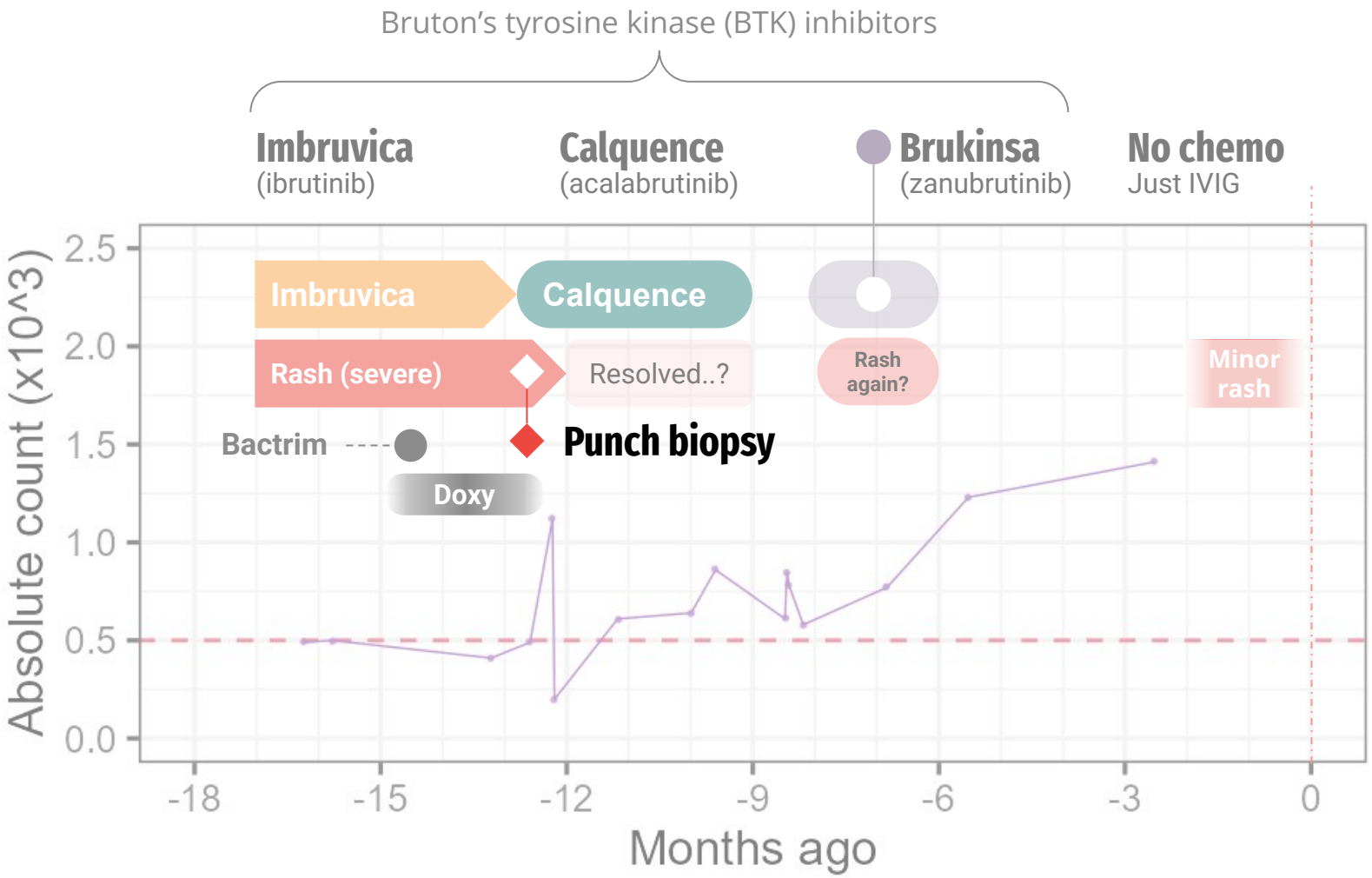


Imbruvica
(ibrutinib)

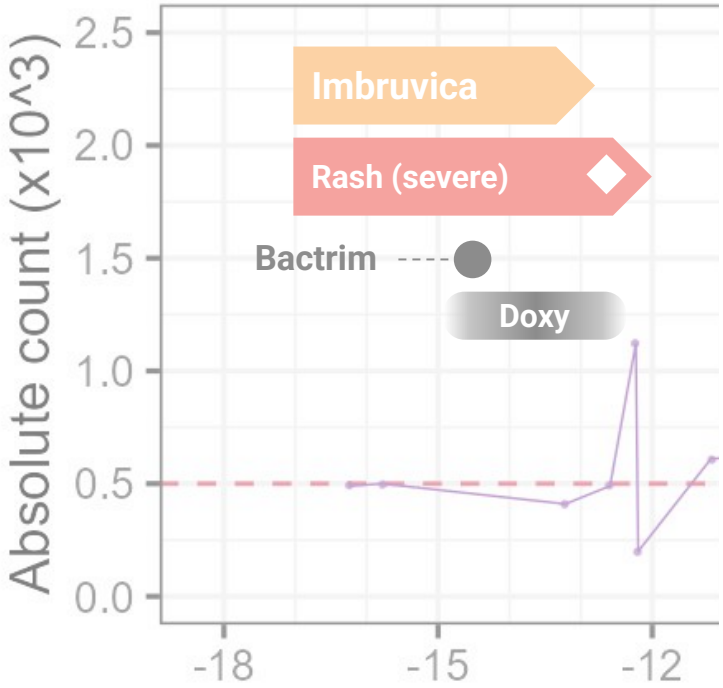



Imbruvica
(ibrutinib)
Calquence
(acalabrutinib)
Imbruvica
Calquence
Rash
Resolved..?
Bactrim
Doxy
Absolute count (x10^3)
2.5
2.0
1.5
1.0
0.5
0.0
-18
-15
-12
-9
-6
-3
0
Months ago


Bruton's tyrosine kinase (BTK) inhibitors
Imbruvica
(ibrutinib)
Calquence
(acalabrutinib)
Brukinsa
(zanubrutinib)
No chemo
Just IVIG
Imbruvica
Calquence
Rash (severe)
Resolved..?
Rash again?
Minor rash
Bactrim
Doxy
Absolute count (x10^3)
2.5
2.0
1.5
1.0
0.5
0.0
-18
-15
-12
-9
-6
-3
0
Months ago


Bruton's tyrosine kinase (BTK) inhibitors
Imbruvica
(ibrutinib)
Calquence
(acalabrutinib)
Brukinsa
(zanubrutinib)
No chemo
Just IVIG
Imbruvica
Calquence
Rash (severe)
Resolved..?
Rash again?
Minor rash
Bactrim
Punch biopsy
Doxy
Absolute count (x10^3)
2.5
2.0
1.5
1.0
0.5
0.0
-18
-15
-12
-9
-6
-3
0
Months ago

Case 1: Old Bx



Punch biopsy of arm

Subacute spongiotic dermatitis with **superficial lymphocytic cell infiltrates** and **actinic changes**, see Comment

These findings are **entirely non-specific** and those of a subacute to chronic spongiotic dermatitis with **superficial predominant perivascular infiltrates** associated (possibly secondarily) with actinic damage. **Eczematized actinic keratosis is possible**; but Epic indicates this biopsy is a portion of a broader eruption. A **spongiotic drug eruption is a possibility**, or even an erythema reaction due to rubbing may also be explain these histopathologic findings.

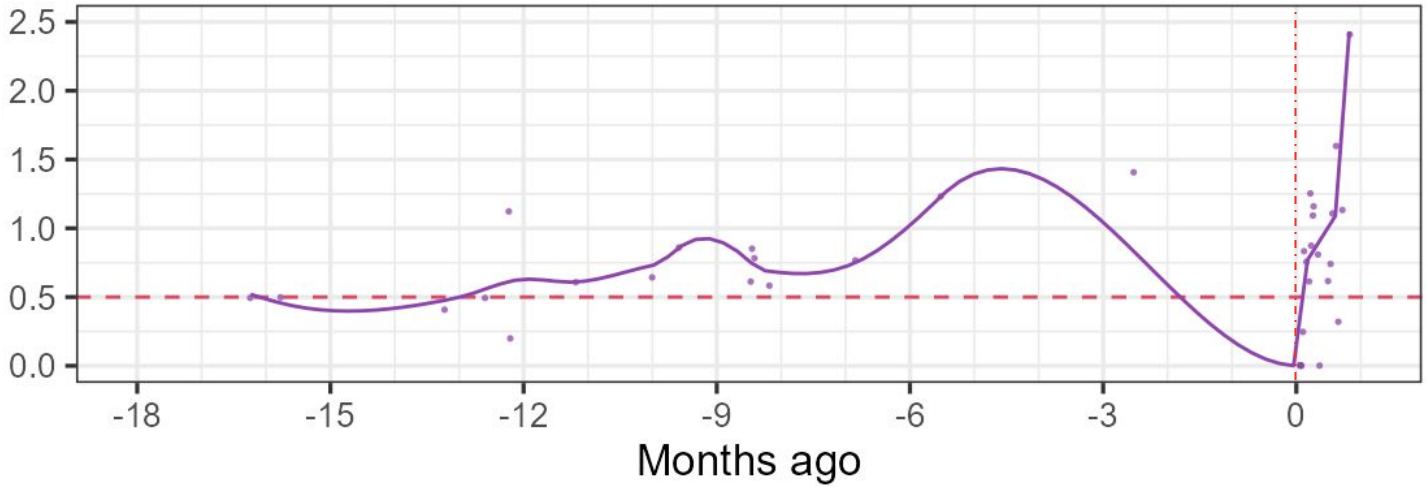
There are **no overt tumoral infiltrates** to suggest a fully developed leukemia cutis. A connective tissue disorder is unlikely but cannot be excluded with complete surety. These histopathological features would **not be characteristically seen** in subacute cutaneous lupus nor Sweet's syndrome. The direct immunofluorescence studies are nonspecific.

Case 1: ID clinic follow up

Did not suspect issues to be related to antibiotics

- Still **changed to Zyvox** (hard to continue dapto with eosinophils > 2k)

Strongly advised **prompt hematology follow up**



MARS call #2

Artemis II Commander Reid Wiseman peers out Orion's main cabin windows, as the crew travels towards the Moon

April 2nd, 2026
Image credit: JSC/NASA

MARS #2: HPI

You are called after **multiple crew members** of the **ISS** have come down with **progressive respiratory symptoms**

Artemis II lunar flyby, captured three minutes before the Orion spacecraft went behind the Moon
Credit: NASA (4/6/2026 19:41 EDT)

MARS #2: HPI

A few months into an **ISS expedition** (mission **month 2.5**), two of the six crew members developed **productive cough** and **dyspnea**

MARS #2: HPI

A few months into an **ISS expedition** (mission **month 2.5**), two of the six crew members developed **productive cough** and **dyspnea**

For the **past six days**, two of the crew members have been feeling ill

- **Three days ago**, one crew member (*Crew A*) **developed fevers**
- **Today**, that same crew member developed **increased work of breathing** and looks pale

MARS #2: HPI

A few months into an **ISS expedition** (mission **month 2.5**), two of the six crew members developed **productive cough** and **dyspnea**

For the **past six days**, two of the crew members have been feeling ill

- **Three days ago**, one crew member (*Crew A*) **developed fevers**
- **Today**, that same crew member developed **increased work of breathing** and looks pale

Antibiotic	(more ill) Astronaut A	Astronaut B
Augmentin	No improvement	No improvement
Bactrim	No improvement	---
Cipro	---	**Mild improvement**

MARS #2: HPI

A few months into an **ISS expedition** (mission **month 2.5**), two of the six crew members developed **productive cough** and **dyspnea** for the past six days. Astronaut B had **mild improvement** with some **Cipro**, but Astronaut A now has **fevers** (for 3 days) and increased **work of breathing** (1 day), despite **Augmentin** and **Bactrim**

Epi risks	Quite ill Crew A	Sick Crew B	Healthy Crew C	Healthy Crew D	Healthy Crew E	Healthy Crew F
Toilet repairs	No	**Yes**	No	**Yes**	**Yes**	No
Electric panel repair	**Yes**	**Yes**	No	**Yes**	No	No
EVA?	**Yes**	**Yes**	**Yes**	No	No	**Yes**
Food source	**Lot 1**	**Lot 1**	**Lot 1**	Lot 2	Lot 2	Lot 2

MARS #2: HPI

A few months into an **ISS expedition** (mission **month 2.5**), two of the six crew members developed **productive cough** and **dyspnea** for the past six days. Astronaut B had **mild improvement** with some **Cipro**, but Astronaut A now has **fevers** (for 3 days) and increased **work of breathing** (1 day), despite **Augmentin** and **Bactrim**. No clear shared epidemiologic risk factors.

Today (day of consult), exam by the crew medical officer (not a physician)

Astronaut A

38.9°C (102.0°F) | 112 bpm | 108/64 | **91%**

- **Accessory muscle** use
- **Rales in RLL** > LLL;
- ↓ breath sounds RLL

Astronaut B

37.8°C (100.0°F) | 104 bpm | 114/70 | **93%**

- **Coughing** on exam
- Diffuse rhonchi & scattered crackles bilaterally

MARS 2: Summary

A few months into an **ISS expedition** (mission **month 2.5**), two of the six crew members developed **productive cough** and **dyspnea** for the past six days. No clear shared epidemiologic risk factors

Astronaut B had **mild improvement** with some **Cipro**, but Astronaut A now has **fevers** (for 3 days) and increased **work of breathing** (1 day), despite **Augmentin** and **Bactrim**.

- Do you abort the mission?

Image Credit: NASA/Joel Kowsky (Artemis II Launch)

MARS: Space is dirty! [1][3]

Intuition: The ISS should be clean, like an operating room

MARS: Space is dirty! [1][3]

Intuition: The ISS should be clean, like an operating room

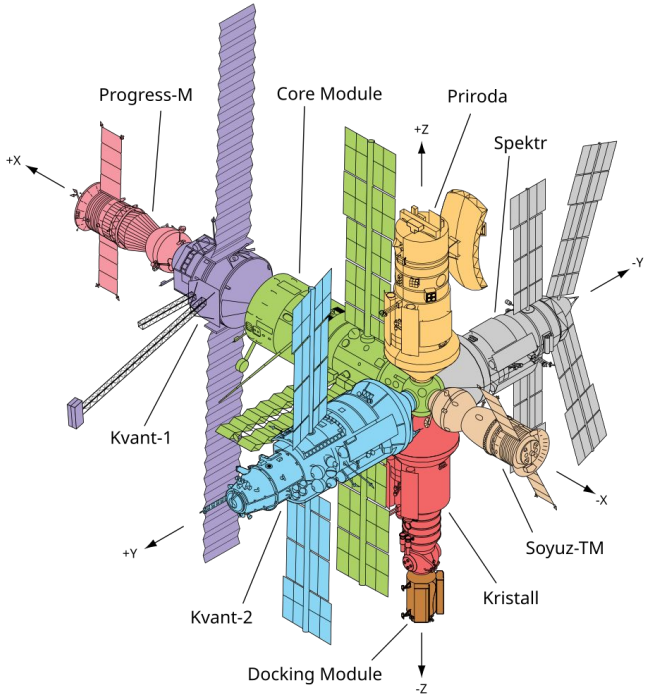
Reality: The microbiology of the ISS is much closer to an ICU

Over 15+ years, microbes have really built up

- Mainly skin flora (staph, micrococcus, strep, bacillus)
- But that's not all...!

MARS: Space is dirty [3]

When NASA removed a **service panel** and **found a humid cloud of condensate**

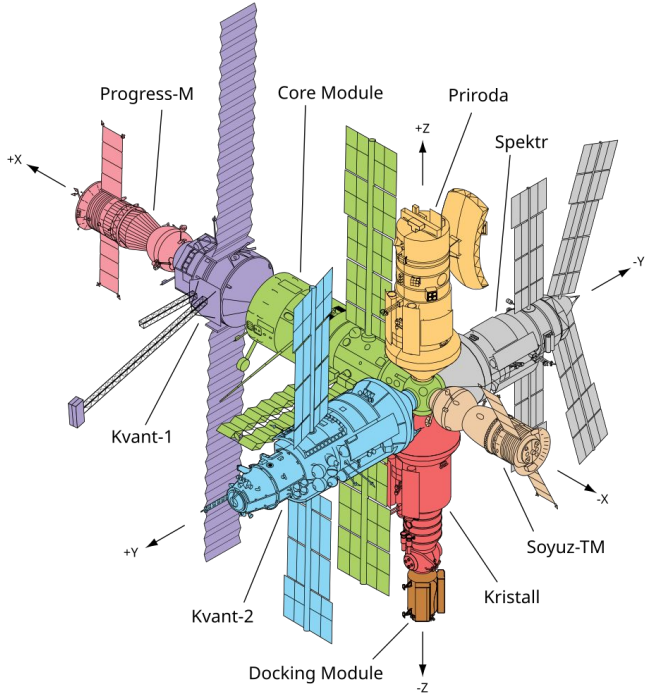


Isolated from Mir in 1998, the first space station (Soviet station)

MARS: Space is dirty [3]

When NASA removed a **service panel** and **found a humid cloud of condensate**

AI generated image (I have no idea what it looked like)



Isolated from Mir in 1998, the first space station (Soviet station)

Guess what they isolated?

MARS: Space is dirty [3]

Isolated from Mir space station (1998)

- Multiple species of:
  - **Serratia** (S liquefaciens, S marcescens)
  - **Pseudomonas**
  - **Yersinia**
  - **Corynebacterium** & **Bacillus**
- **Legionella** (x2)
- ***Citrobacter frundii*** (x2)
- ***Enterobacter cloacae***
- ***Stenotrophomonas maltophilia***
- ***Elizabethkingia meningoseptica***
- ***Rhodococcus*** species

Space horses?

AI generated image (I have no idea what it looked like)

MARS: Space is dirty [3]

Isolated from Mir space station (1998)

- Multiple species of:
  - **Serratia** (S liquefaciens, S marcescens)
  - **Pseudomonas**
  - **Yersinia**
  - **Corynebacterium** & **Bacillus**
- **Legionella** (x2)
- ***Citrobacter frundii*** (x2)
- ***Enterobacter cloacae***
- ***Stenotrophomonas maltophilia***
- ***Elizabethkingia meningoseptica***
- ***Rhodococcus*** species

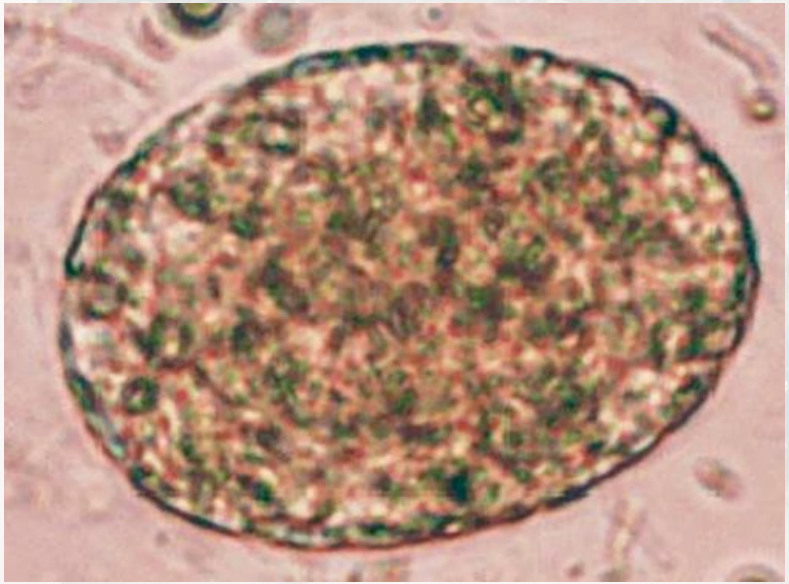
Space horses?

Fungal

- Multiple species of **Candida**
- **Fusarium** species (x3)
- **Penicillium** species (x3)
- Rhodotorula rubra (x3)
- Cladosporium species (x2)
- And more

AI generated image (I have no idea what it looked like)

MARS: Space is dirty [3]



Amoeba resembling *Acanthamoeba* or *Hartmanella* species

Ciliated protozoa resembling Stylonychia species

MARS: Space is dirty [3]

Isolated from Mir space station (1998)

- Multiple species of **Serratia**, **Pseudomonas**, **Yersinia**, **Corynebacterium**, & **Bacillus**
- **Legionella** (x2)
- ***Citrobacter frundii*** & ***Enterobacter cloacae***
- ***Stenotrophomonas*** & ***Elizabethkingia***
- ***Rhodococcus*** species
- **Amoeba** & **protozoa**

Fungal

- Multiple species of **Candida**
- **Fusarium** species (x3)
- **Penicillium** species (x3)
- Rhodotorula rubra (x3)
- Cladosporium species (x2)
- And more

Lyme? Lepto?

Electron microscopy suggested presence of **spirochetes**

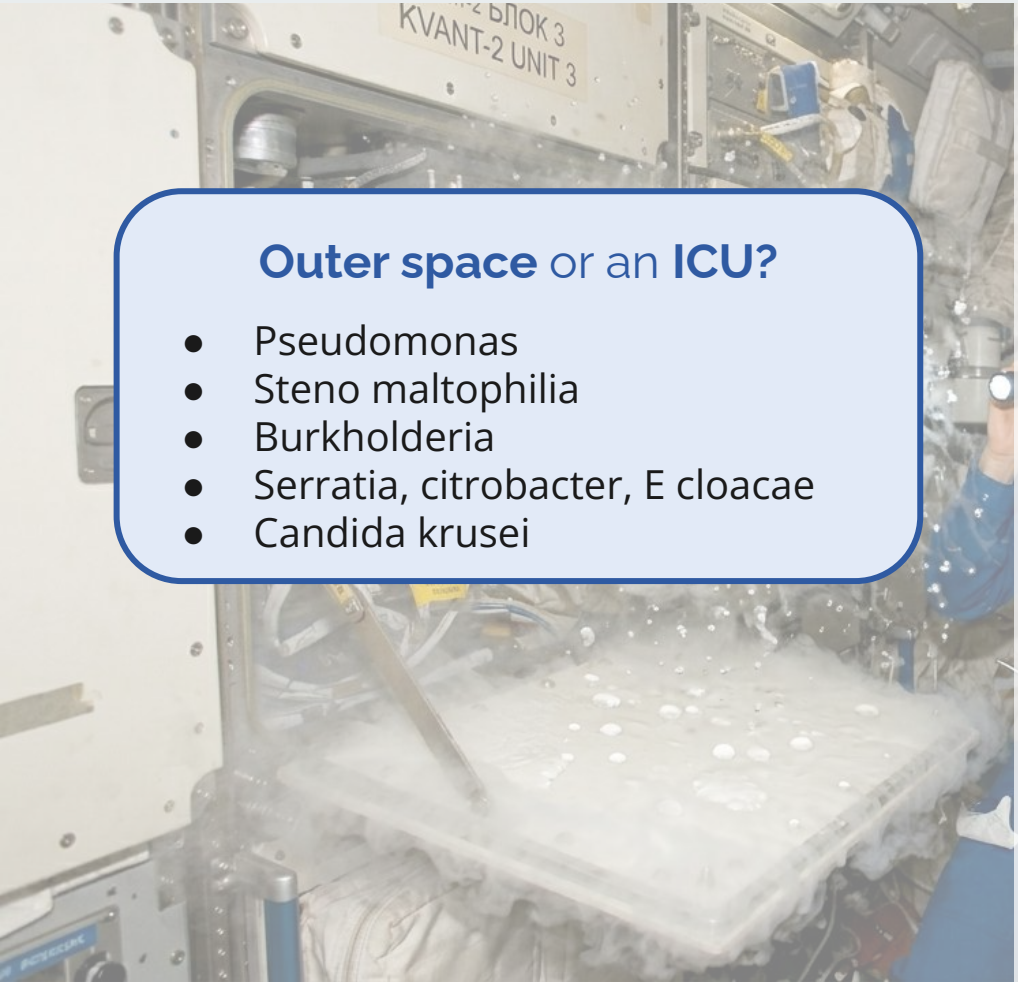
No mycobacteria (at least yet)

Surely the life support systems aren't as contaminated, right?

It's not like they are drinking fluid from behind a service panel...

Surely the **life support systems** aren't as contaminated, right?

During space shuttle program, the **potable water** (generated by the fuel cells) was commonly contaminated with **low levels of Burkholderia cepacia**



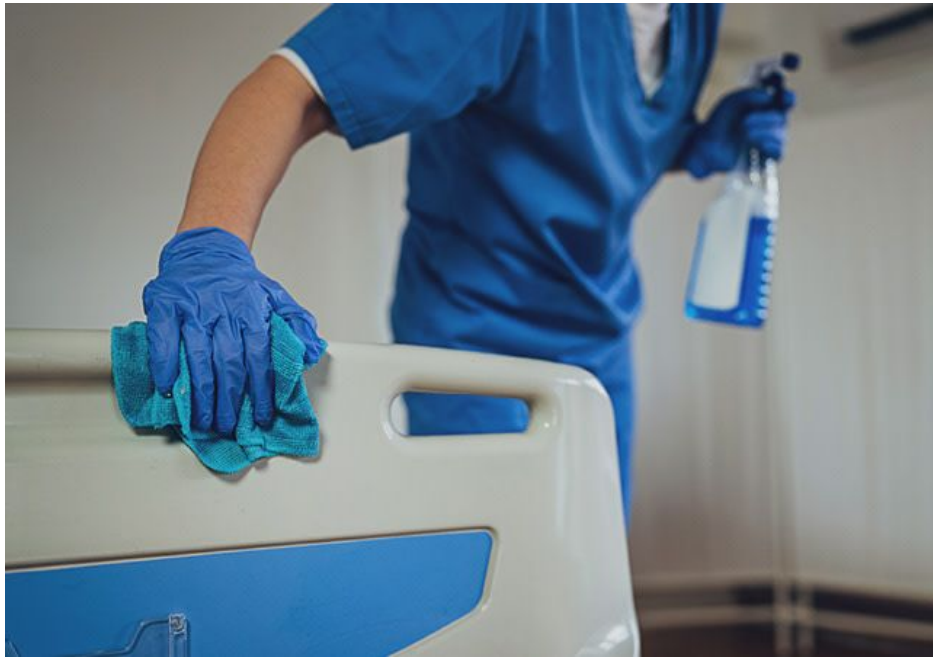
Outer space or an ICU?

- Pseudomonas
- Steno maltophilia
- Burkholderia
- Serratia, citrobacter, E cloacae
- Candida krusei

Surely the life support systems aren't as contaminated, right?

During space shuttle program, the **potable water** (generated by the fuel cells) was commonly contaminated with **low levels of Burkholderia cepacia**

MARS: Infection Prevention & Control



Standard environmental disinfection practices (wipes, UV radiation) **do not work** well, because the bacteria are different

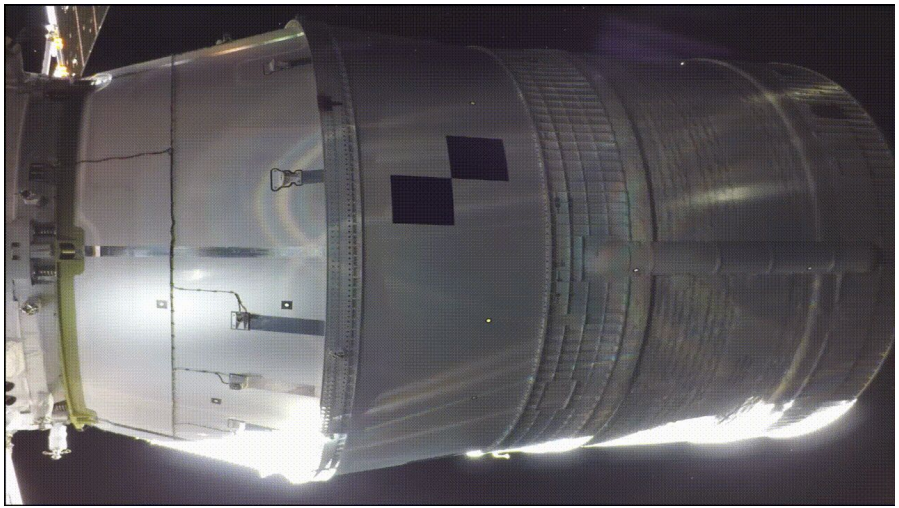
Because there is no gravity!

MARS: Pathogen responses to microgravity [1]

Spaceflight doesn't just affect human physiology, it also affects pathogens too!

Driven by Lack of Gravity

- **Fluids** are much **more static** (no convection) compared to terrestrial environment



Artemis II Upper Stage Separation
Image credit: NASA (4/1/2026)

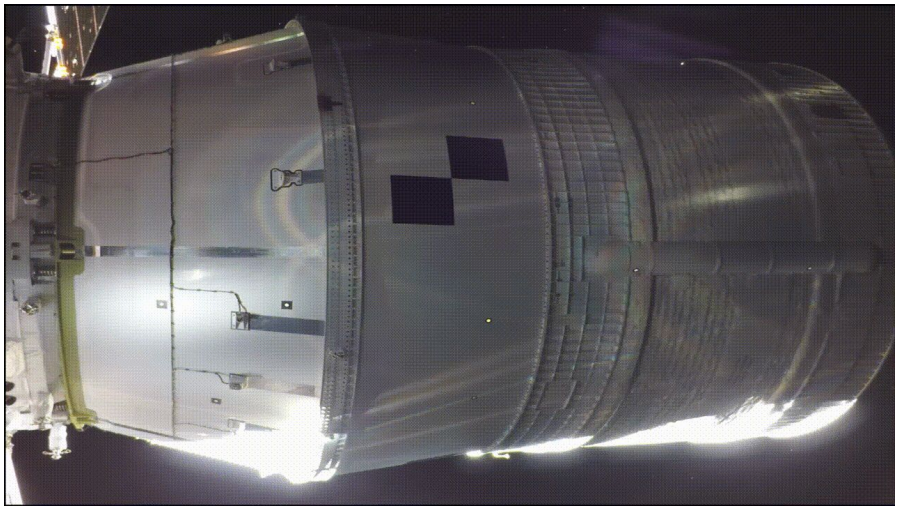
MARS: Pathogen responses to microgravity [1]

Spaceflight doesn't just affect human physiology, it also affects pathogens too!

Driven by Lack of Gravity

- **Fluids** are much **more static** (no convection) compared to terrestrial environment
- Bacteria rely on **passive diffusion** for nutrients and waste removal

  Exception: Bacteria with **flagella maintain** active transport capabilities



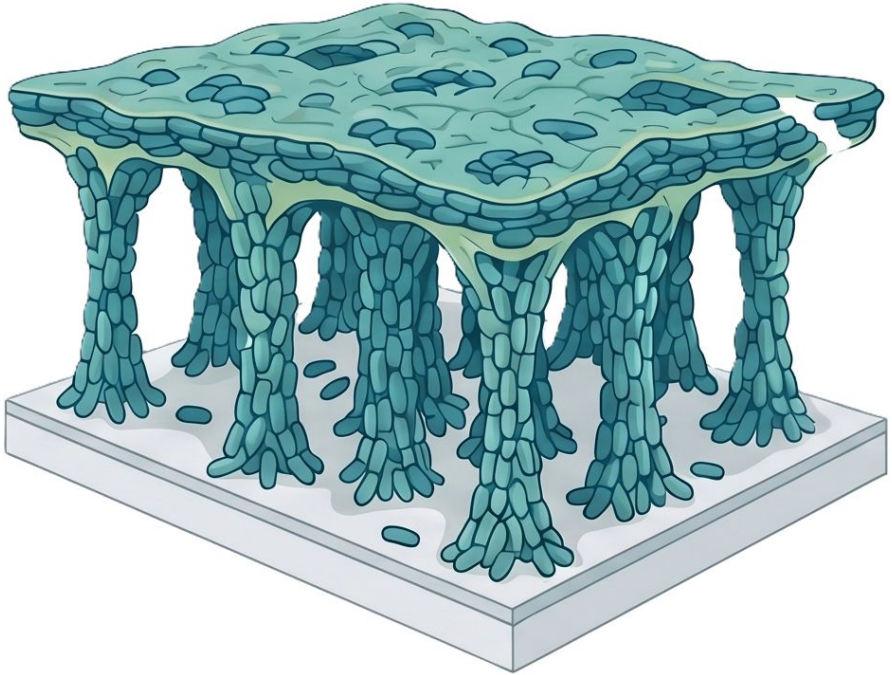
Artemis II Upper Stage Separation
Image credit: NASA (4/1/2026)

MARS: Pathogen responses to microgravity [1]

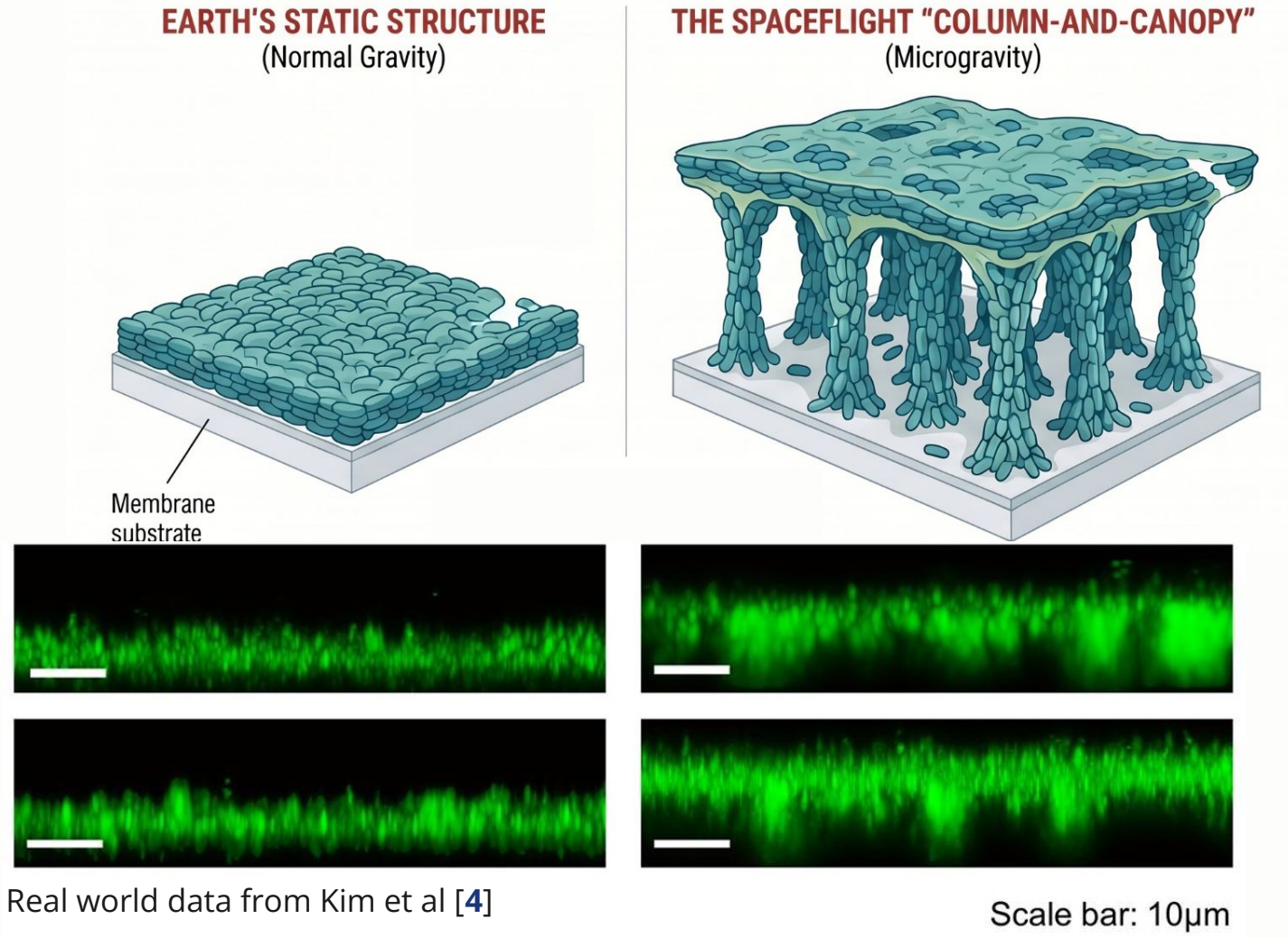
Pseudomonas overcomes diffusion limitations in microgravity by building **unique biofilms** [4]

Structure never seen on Earth:

- Thicker overall matrix
- **"Column and canopy"** architecture
- Optimized for **nutrient diffusion**



AI generated image (Google NotebookLM)



Real world data from Kim et al [4]

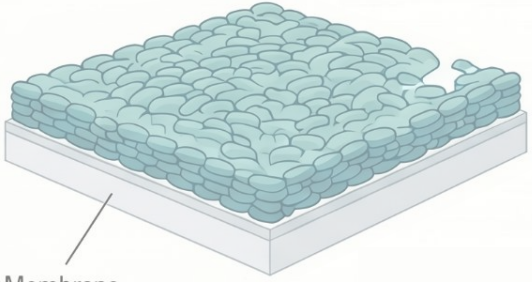
Architecture of the Void: The Unique “Column-and-Canopy” Biofilms of Space

Research from Space Shuttle missions STS-132 & STS-135 revealed that *Pseudomonas aeruginosa* forms a novel “column-and-canopy” biofilm architecture in microgravity, characterized by increased biomass, thickness, and void space, never observed under static Earth conditions.

EARTH'S STATIC STRUCTURE

(Normal Gravity)

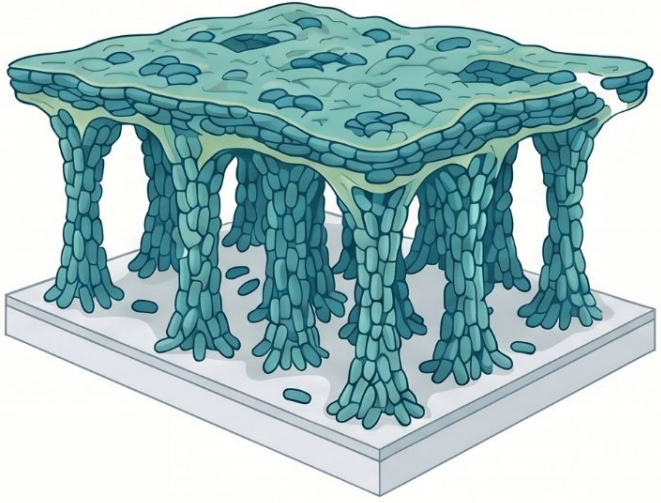
1.8x
Increase in Void Fraction



Typically forms thin, flat, and uniformly dense biofilms.

THE SPACEFLIGHT “COLUMN-AND-CANOPY”

(Microgravity)

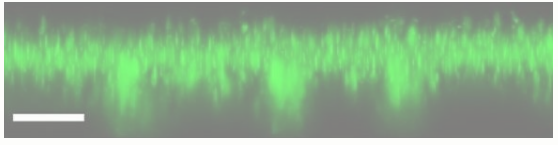


Microgravity triggers a 3D architecture consisting of dense cell aggregates forming vertical “columns” supporting a mat-like “canopy” on top.

BIOLOGICAL DRIVERS & IMPACT

THE NECESSITY OF MOTILITY

Flagella-driven motility is essential for this formation, bacteria without the ability to swim fail to create the column-and-canopy shape.

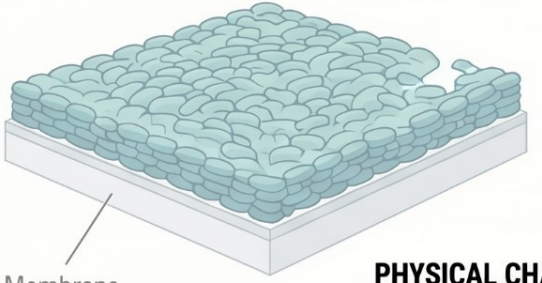


Architecture of the Void: The Unique "Column-and-Canopy" Biofilms of Space

Research from Space Shuttle missions STS-132 & STS-135 revealed that *Pseudomonas aeruginosa* forms a novel "column-and-canopy" biofilm architecture in microgravity, characterized by increased biomass, thickness, and void space, never observed under static Earth conditions.

EARTH'S STATIC STRUCTURE
(Normal Gravity)

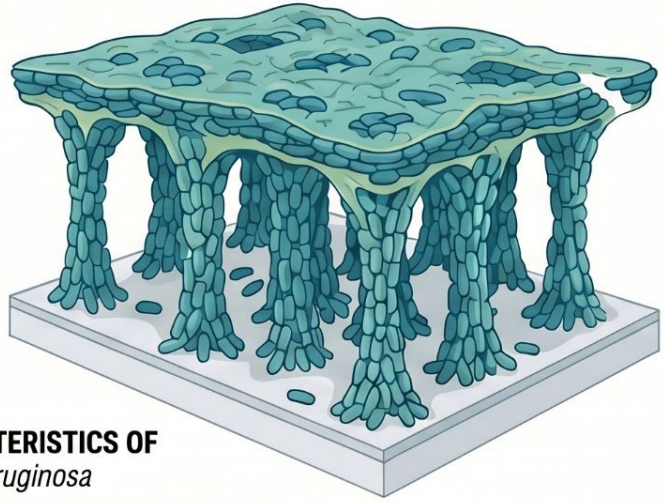
1.8x
Increase in Void Fraction



Membrane substrate

Typically forms thin, flat, and uniformly dense biofilms.

THE SPACEFLIGHT "COLUMN-AND-CANOPY"
(Microgravity)



Microgravity triggers a 3D architecture consisting of dense cell aggregates forming vertical "columns" supporting a mat-like "canopy" on top.

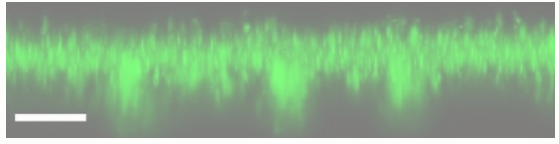
PHYSICAL CHARACTERISTICS OF
Wild Type *P. aeruginosa*

5.4 ± 0.5 µm	Mean Thickness	**9.8 ± 1.0 µm**
3.7 ± 0.1 µm³/µm²	Biomass	**5.0 ± 0.4 µm³/µm²**
0.26 ± 0.05	Void Fraction	**0.47 ± 0.02**

BIOLOGICAL DRIVERS & IMPACT

THE NECESSITY OF MOTILITY
Flagella-driven motility is essential for this formation, bacteria without the ability to swim fail to create the column-and-canopy shape.

INCREASED BIOFILM PROLIFERATION
Spaceflight biofilms show a 3-fold increase in viable cell counts and significantly greater mean thickness compared to Earth controls.



Returning to Earth

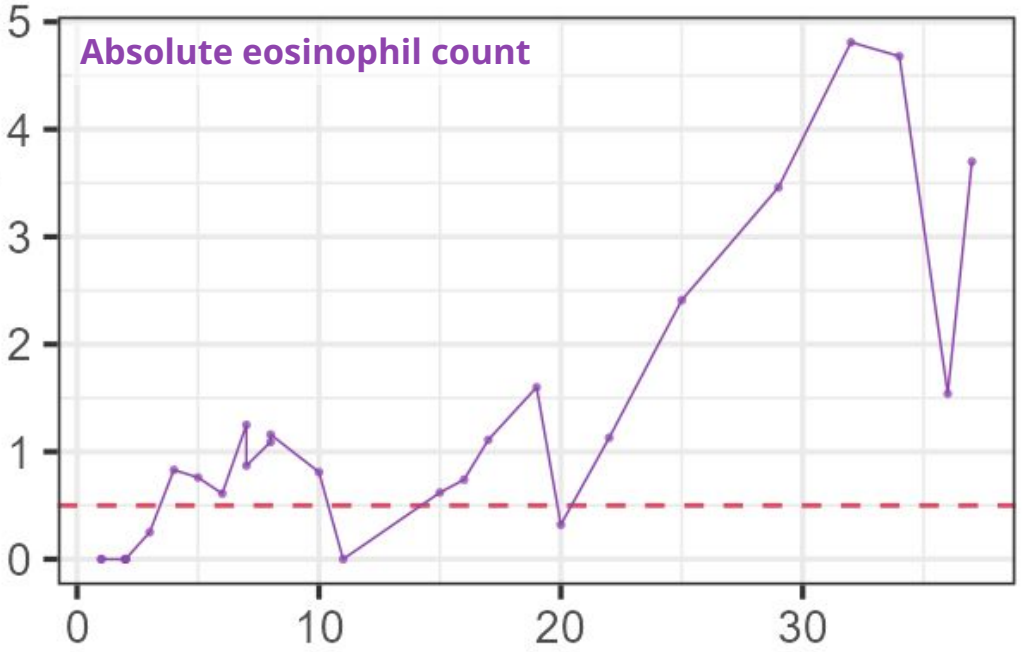
Mission Control (April 7th)
Image Credit: NASA/Robert Markowitz

Case 1: Readmission to OSH

Presents to local hospital due to
worsening pruritus (and ?dyspnea)

Case 1: Readmission to OSH

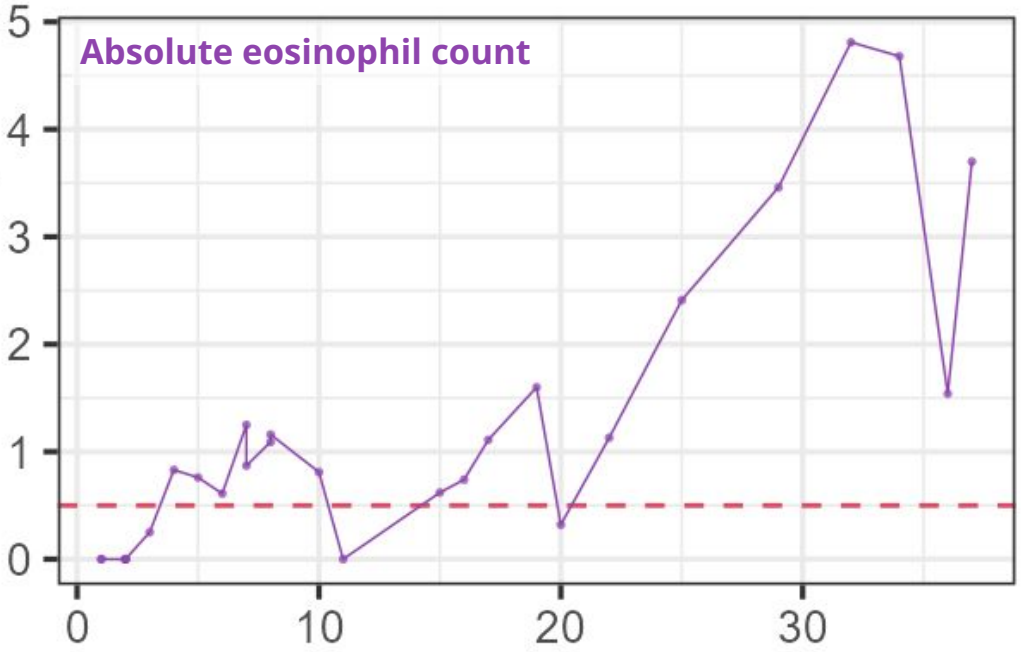
Presents to local hospital due to **worsening pruritus** (and ?dyspnea)



Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

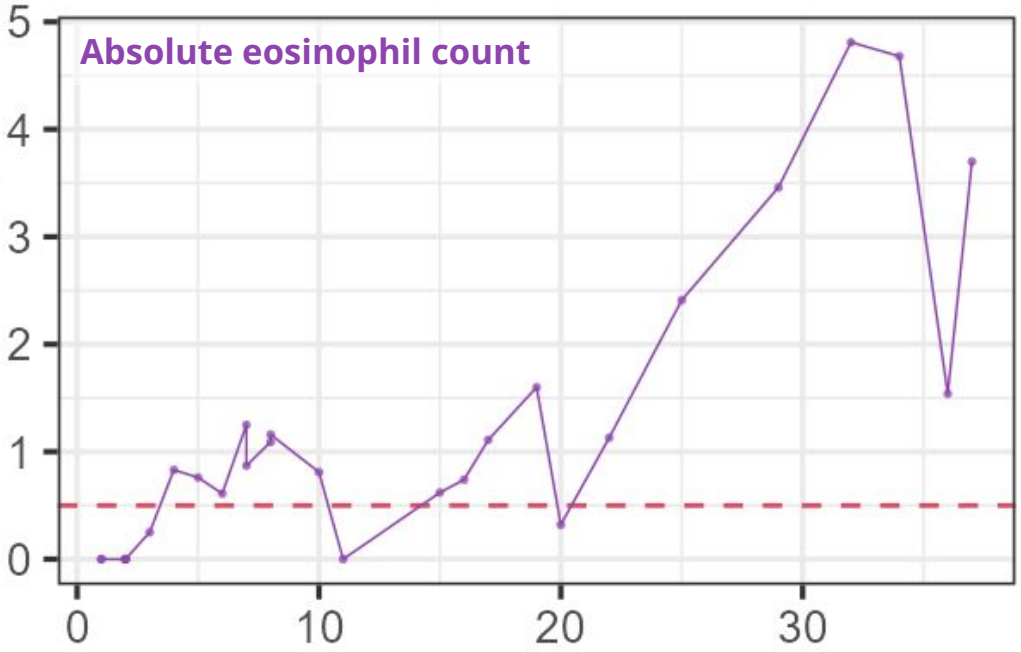
- Gets steroids with improvement
- Seen by **hematology**



Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

- Gets steroids with improvement
- Seen by **hematology**
  - **"Not due to chemo"**
  - ...because **he isn't on chemo**



Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

- Gets steroids with improvement
- Seen by **hematology**
  - **"Not due to chemo"**
  - ...because **he isn't on chemo**

Seen by ID there

Outside ID note:

The cause of the eosinophilia is uncertain. I do not suspect this is due to Linezolid

While the steroids have resolved the eosinophils temporarily, **needs workup to determine the etiology** of the eosinophils (and **evaluation for any end organ dysfunction** - **TTE pending**).

Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

- Gets steroids with improvement
- Seen by **hematology**
  - **"Not due to chemo"**
  - ...because **he isn't on chemo**

Seen by ID there

Outside ID note:

The cause of the eosinophilia is uncertain. I do not suspect this is due to Linezolid

While the steroids have resolved the eosinophils temporarily, **needs workup to determine the etiology** of the eosinophils (and **evaluation for any end organ dysfunction** - **TTE pending**).

He is a hunter and while he does not report history of red meat allergy, **alpha gal is a consideration** given **his recent bovine valve**.

Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

Seen by ID there

- IgE levels:
- Tryptase:
- Strongyloides:
- Trichinella Ab:
- Alpha gal profile:

Outside ID note:

The cause of the eosinophilia is uncertain. I do not suspect this is due to Linezolid

While the steroids have resolved the eosinophils temporarily, **needs workup to determine the etiology** of the eosinophils (and **evaluation for any end organ dysfunction** - **TTE pending**).

He is a hunter and while he does not report history of red meat allergy, **alpha gal is a consideration** given **his recent bovine valve**.

Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

Seen by ID there

- IgE levels: **8.4** (normal)
- Tryptase: **5.0** (normal)
- Strongyloides:
- Trichinella Ab:
- Alpha gal profile:

Outside ID note:

The cause of the eosinophilia is uncertain. I do not suspect this is due to Linezolid

While the steroids have resolved the eosinophils temporarily, **needs workup to determine the etiology** of the eosinophils (and **evaluation for any end organ dysfunction** - **TTE pending**).

He is a hunter and while he does not report history of red meat allergy, **alpha gal is a consideration** given **his recent bovine valve**.

Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

Seen by ID there

- IgE levels: **8.4** (normal)
- Tryptase: **5.0** (normal)
- Strongyloides: **negative**
- Trichinella Ab: **negative**
- Alpha gal profile: **negative**

Outside ID note:

The cause of the eosinophilia is uncertain. I do not suspect this is due to Linezolid

While the steroids have resolved the eosinophils temporarily, **needs workup to determine the etiology** of the eosinophils (and **evaluation for any end organ dysfunction** - **TTE pending**).

He is a hunter and while he does not report history of red meat allergy, **alpha gal is a consideration** given **his recent bovine valve**.

Case 1: Readmission to OSH

Presents to local hospital due to **worsening pruritus** (and ?dyspnea)

Seen by ID there

- IgE levels: **8.4** (normal)
- Tryptase: **5.0** (normal)
- Strongyloides: **negative**
- Trichinella Ab: **negative**
- Alpha gal profile: **negative**

Discharged with:

- Steroids
- Allergy referral
- Derm follow up

Outside ID note:

The cause of the eosinophilia is uncertain. I do not suspect this is due to Linezolid

While the steroids have resolved the eosinophils temporarily, **needs workup to determine the etiology** of the eosinophils (and **evaluation for any end organ dysfunction** - **TTE pending**).

He is a hunter and while he does not report history of red meat allergy, **alpha gal is a consideration** given **his recent bovine valve**.

Case 1: Going to another system

Opts for a **second opinion** in another hospital system (agreed) and sees:

HemeOnc

Dermatology

Infectious Diseases

Case 1: Going to another system

Opts for a **second opinion** in another hospital system (agreed) and sees:

HemeOnc

- **PET/CT** and **bone marrow Bx** to confirm SLL still in remission
- Results **still pending**

Dermatology

Infectious Diseases

Case 1: Going to another system

Opts for a **second opinion** in another hospital system (agreed) and sees:

HemeOnc

- **PET/CT** and **bone marrow Bx** to confirm SLL still in remission
- Results **still pending**

Dermatology

- Felt to be **eosinophilic dermatosis of hematologic malignancy**
- **Gets punch Bx**
  - Confirms the Dx
  - Might get Dupixent

Infectious Diseases

Case 1: Going to another system

Opts for a **second opinion** in another hospital system (agreed) and sees:

HemeOnc

- **PET/CT** and **bone marrow Bx** to confirm SLL still in remission
- Results **still pending**

Dermatology

- Felt to be **eosinophilic dermatosis of hematologic malignancy**
- **Gets punch Bx**
  - Confirms the Dx
  - Might get Dupixent

Infectious Diseases

- **Do not** think it is infectious
- Order **histoplasmosis & toxocara** (negative)
- Plan to **use PET/CT to guide duration** of the doxy

Alpha-Gal after bioprosthetic valve

Not that the patient had this, but great idea from OSH infectious disease team

Links to article discussed here

Alpha-gal & bioprosthetic valves [7]

Mechanism of complication

Presence of alpha-gal epitopes in bovine and porcine bioprosthetic valves

Potential Responses:

- Eosinophilic infiltration of valve tissue
- Risk of systemic anaphylaxis

Case report

Patient tolerated pork but reacted to beef. Management included:

- Pre-treatment with steroids
- Montelukast & Cetirizine
- Diphenhydramine

Recommendation for "Challenge" Decision

Use an **alpha-gal–specific IgE to total IgE ratio of 5%** as a cutoff threshold to consider bioprosthetic valve challenge.

Note: Data is currently very limited regarding "challenging" with bioprosthetic valves.

MARS call #3

NASA’s Orion spacecraft is pictured here from one of the cameras mounted on its solar array wings

April 7th, 2026 on 8:58 a.m. ET (mission day 7)
Image credit: JSC/NASA

MARS #3: HPI

A **31 y/o F** astronaut presents on **mission day 60** for **erythema + calor** on the skin surrounding a recent **left elbow abrasion**

MARS #3: HPI

A **31 y/o F** astronaut presents on **mission day 60** for **erythema + calor** on the skin surrounding a recent **left elbow abrasion**

- A week ago, noticed a **pimple** over her elbow after a prolonged EVA
  - No *overt lacerations* or skin breakdown
- In following days, noticed
  - **Erythema** developing around the area
  - Mild **pain**

EVA = “Spacewalk”
(Extravehicular Activity)

MARS #3: HPI

A **31 y/o F** astronaut presents on **mission day 60** for **erythema + calor** on the skin surrounding a recent **left elbow abrasion**

- A week ago, noticed a **pimple** over her elbow after a prolonged EVA
  - No *overt lacerations* or skin breakdown
- In following days, noticed
  - **Erythema** developing around the area
  - Mild **pain**
- **3 days ago**, flight surgeon (at mission control) evaluated case
  - Felt to be **skin and soft tissue infection**
  - Recommended **Augmentin**

EVA = “Spacewalk”
(Extravehicular Activity)

MARS #3: HPI

A **31 y/o F** astronaut presents on **mission day 60** for **erythema + calor** on the skin surrounding a recent **left elbow abrasion**

- A week ago, noticed a **pimple** over her elbow after a prolonged EVA
  - No *overt lacerations* or skin breakdown
- In following days, noticed
  - **Erythema** developing around the area
  - Mild **pain**
- **3 days ago**, flight surgeon (at mission control) evaluated case
  - Felt to be **skin and soft tissue infection**
  - Recommended **Augmentin**
- **No improvement** on antibiotics

EVA = “Spacewalk”
(Extravehicular Activity)

MARS #3: HPI

A **31 y/o F** astronaut evaluated for **abscess of left elbow** that has been ongoing **after prolonged EVA** on mission **day 60**. On mission **day 64**, flight surgeon started **Augmentin**, with no improvement.

Mission control guides the crew medical officer (not a physician) on **point of care ultrasound** (**day 67**)

- Identifies a **5mm abscess** limited to SQ tissue
- Performs an **I&D with purulent discharge**

MARS #3: HPI

A **31 y/o F** astronaut evaluated for **abscess of left elbow** that has been ongoing **after prolonged EVA** on mission **day 60**. On mission **day 64**, flight surgeon started **Augmentin**, with no improvement.

Mission control guides the crew medical officer (not a physician) on **point of care ultrasound** (**day 67**)

- Identifies a **5mm abscess** limited to SQ tissue
- Performs an **I&D with purulent discharge**

Pretend this was somehow available on board (unlikely to be the case)

- Gram stain shows **GPC in clusters**
- **MecA** testing was **negative**

MARS 3: Summary

A **31 y/o F** astronaut evaluated for **abscess of left elbow** that has been ongoing **after prolonged EVA** on mission **day 60**. On mission **day 64**, flight surgeon started **Augmentin**, with no improvement.

On **day 67**, POCUS shows **5mm abscess**

- I&D with purulent material
- GPC in clusters on gram stain
- MecA negative

T 37.6°C, HR 93, BP 100/64

- What is the suspected pathogen?
- Why isn't she responding to Augmentin?

MARS: Are the bacteria more virulent? [1]

Early in our ventures into space (Salyut 7), there was a great deal of concern that bacteria transformed into **superbugs** in space

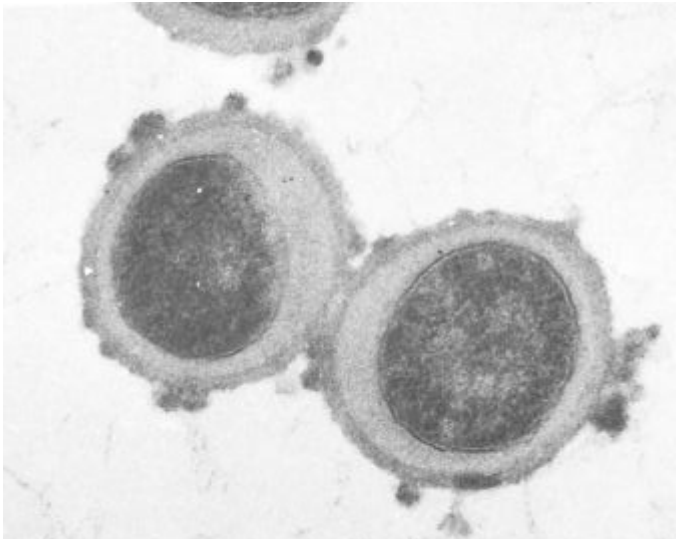
Intuition: **Hypermutations** from **radiation** & **stress of microgravity**

MARS: Are the bacteria more virulent? [1]

Early in our ventures into space (Salyut 7), there was a great deal of concern that bacteria transformed into **superbugs** in space

In 1982, **staph aureus isolates** (seemingly) changed to appear **morphologically similar to VISA**

Intuition: **Hypermutations** from **radiation** & **stress of microgravity**



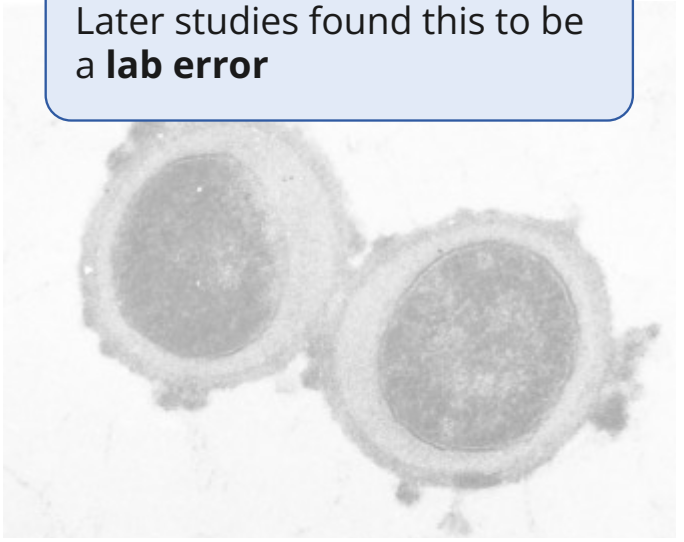
MARS: Are the bacteria more virulent? [1]

Early in our ventures into space (Salyut 7), there was a great deal of concern that bacteria transformed into **superbugs** in space

Intuition: **Hypermutations** from **radiation** & **stress of microgravity**

In 1982, **staph aureus isolates** (seemingly) changed to appear **morphologically similar to VISA**

Later studies found this to be a **lab error**



MARS: Are the bacteria more virulent? [1]

We can model microgravity pretty well on Earth using LSMMG

Low-Shear Modeled Microgravity

Ground based bioreactors (HARVs) simulate the space environment with constant suspension via rotation

MARS: Are the bacteria more virulent? [1]

We can model microgravity pretty well on Earth using LSMMG

Mice studies with **Salmonella** found:

- ↑↑ acid tolerance
- Faster colonization
- ↓↓ LD50

Low-Shear Modeled Microgravity

Ground based bioreactors (HARVs) simulate the space environment with constant suspension via rotation

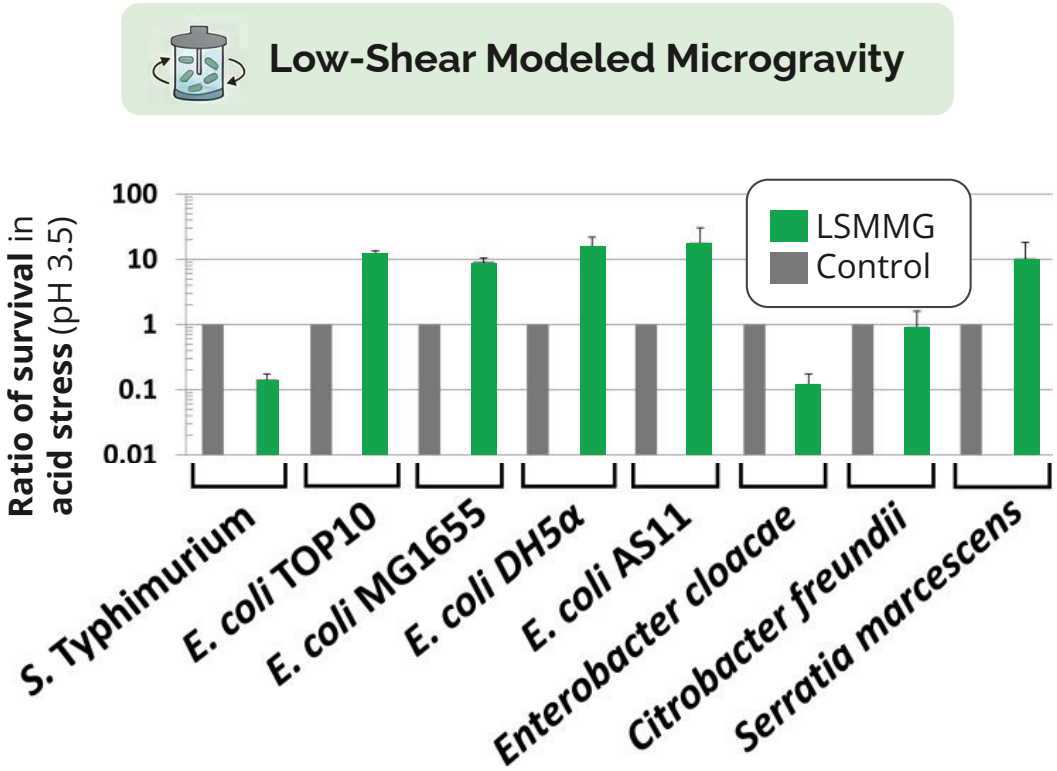
MARS: Are the bacteria more virulent? [1]

We can model microgravity pretty well on Earth using LSMMG

Mice studies with **Salmonella** found:

- ↑↑ acid tolerance
- Faster colonization
- ↓↓ LD50

Similar findings for other gram negatives (**Enterobacterales**) [5]



MARS: Are the bacteria more virulent? [1][5]

We can model microgravity pretty well on Earth using LSMMG

- Might make **gram negatives more virulent**

For **gram positives**, microgravity seems to **decrease virulence**

- **Decreased hemolysins** (MRSA)
- Tendency to shift from **planktonic → biofilm**

Low-Shear Modeled Microgravity

MARS: Are the bacteria more virulent? [1][5]

We can model microgravity pretty well on Earth using LSMMG

- Might make **gram negatives more virulent**
- For **gram positives**, seems to **decrease virulence**

Low-Shear Modeled Microgravity

Spaceflight is more than microgravity

Numerous other factors in space, which are **hard to replicate on Earth**

- Acceleration
- Radiation
- Electromagnetism
- Vibration

MARS: Are the bacteria more virulent? [1][5]

We can model microgravity pretty well on Earth using LSMMG

- Might make **gram negatives more virulent**
- For **gram positives**, seems to **decrease virulence**

Low-Shear Modeled Microgravity

Spaceflight is more than microgravity

- Acceleration
- Radiation
- Electromagnetism
- Vibration

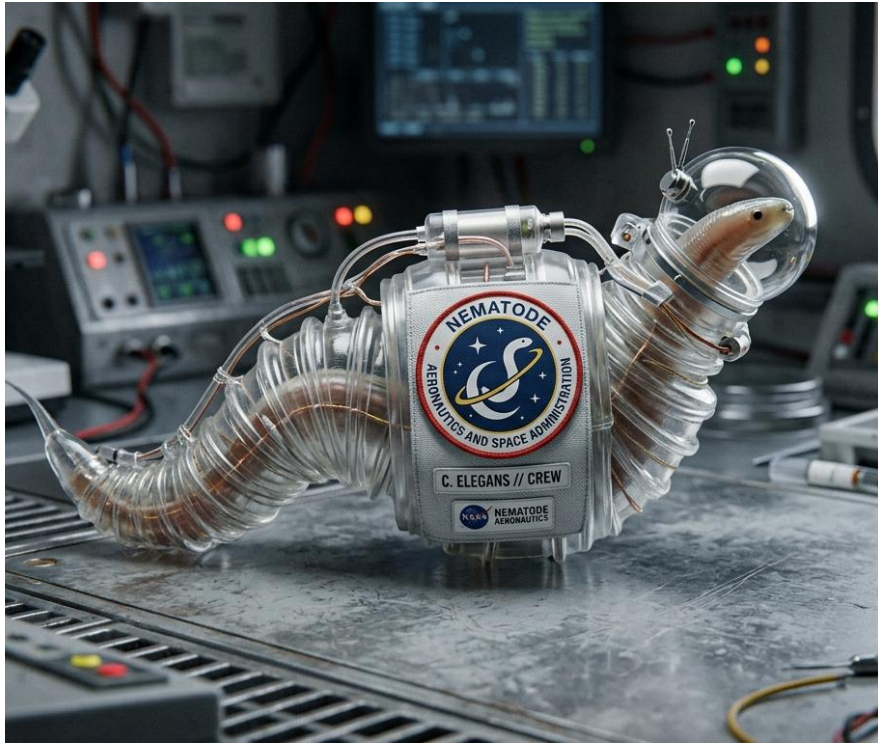
Good microbiology is hard in space

- Specialized equipment = heavy
- Limited space
- Zero G = No convection
- Astronaut time is at a premium
- Contamination

MARS: Are the bacteria more virulent? [1][6]

We have studied worms in space

- **Roundworms** brought to **ISS**
- Did *not* make worm holes



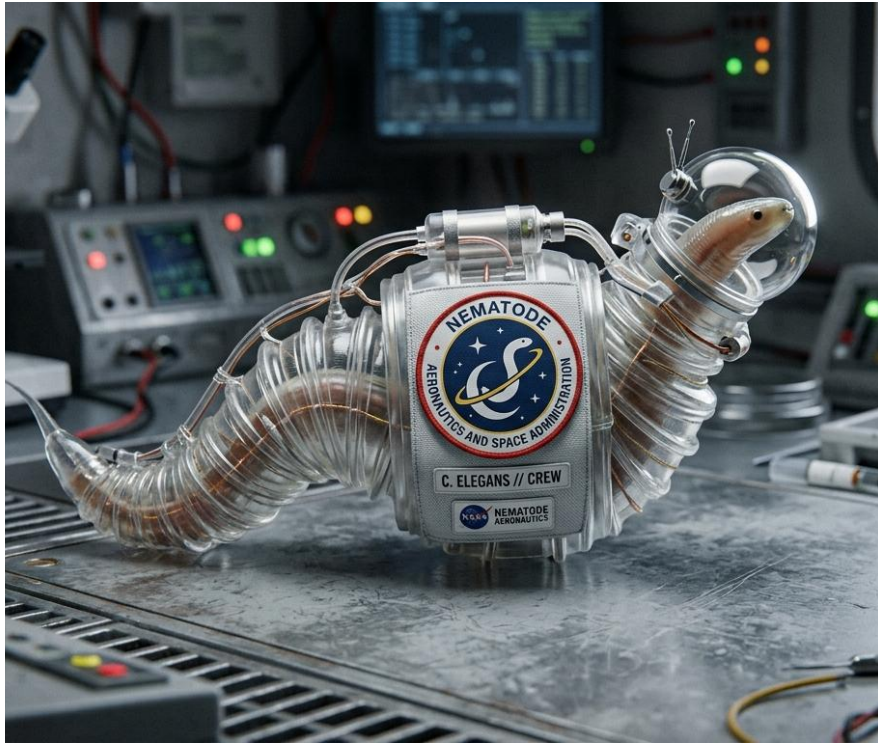
AI generated image, but not a bad design for a roundworm (Nano Banana 2)

MARS: Are the bacteria more virulent? [1][6]

We have studied worms in space

- **Roundworms** brought to **ISS**
- Did *not* make worm holes

(vs ground)	Adult	Larvae
C albicans	↓↓ (p=.06)	↓↓
Listeria	↓↓	↓↓
E faecalis	↓↓	↓↓
MRSA	↓↓	↓↓



AI generated image, but not a bad design for a roundworm (Nano Banana 2)

MARS: Are the bacteria more virulent? [1][6]

We have studied worms in space

- **Roundworms** brought to **ISS**
- Did *not* make worm holes

	Spaceflight		Rotation	
(vs ground)	Adult	Larvae	Adult	Larvae
C albicans	↓↓ (p=.06)	↓↓	---	↓↓
Listeria	↓↓	↓↓	No change	No change
E faecalis	↓↓	↓↓	No change	↓↓
MRSA	↓↓	↓↓	No change	No change

MARS: If it's not the pathogen, what is it? [1]

Antimicrobials on the ISS (in 2015)

- Amikacin
- Amoxicillin
- Azithromycin
- Bactrim
- Vancomycin tablets
- Cefadroxil
- Cipro
- Flagyl
- Many topicals

LSMMG on Earth [5]
Gram neg: ↑↑ virulence
Gram pos: ↓↓ virulence

Nematodes [6]
Less susceptible to MRSA, E faecalis, C albicans, and listeria

MARS: If it's not the pathogen, what is it? [1]

Antimicrobials on the ISS (in 2015)

- Amikacin
- Amoxicillin
- Azithromycin
- Bactrim
- Vancomycin tablets
- Cefadroxil
- Cipro
- Flagyl
- Many topicals

1 in 12 don't work

During the space shuttle program, **8%** of medications were **reported as non-efficacious**

LSMMG on Earth [5]

Gram neg: ↑↑ virulence
Gram pos: ↓↓ virulence

Nematodes [6]

Less susceptible to MRSA, E faecalis, C albicans, and listeria

Medication stability

Medications don't follow the same rules as on Earth

MARS: Medication stability in space [1]

The Study

- 35 formulations of medications
- Compared **Earth vs ISS**
- Stored for **28 months**

Medication stability
Medications don’t follow the same rules as on Earth

MARS: Medication stability in space [1]

Findings

Substantial **reduction in active ingredients** were found in spaceflight medications compared to those kept on Earth

- **Augmentin**
- **Bactrim**

Medication stability
Medications don't follow the same rules as on Earth

MARS: Medication stability in space [1]

Findings

Substantial **reduction in active ingredients** were found in spaceflight medications compared to those kept on Earth

- **Augmentin**
- **Bactrim**

Medication stability
Medications don't follow the same rules as on Earth

Ionizing radiation

Trace moisture from within the pill

Production of **reactive oxygen species** & **free radicals**

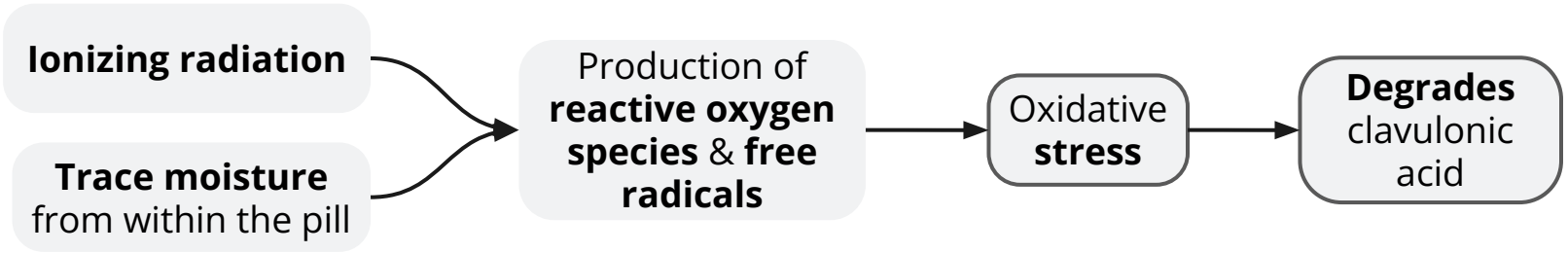
MARS: Medication stability in space [1]

Findings

Substantial **reduction in active ingredients** were found in spaceflight medications compared to those kept on Earth

- **Augmentin**
- **Bactrim**

Medication stability
Medications don't follow the same rules as on Earth



MARS: Medication stability in space [1]

Findings

Substantial **reduction in active ingredients** were found in spaceflight medications compared to those kept on Earth

- **Augmentin**
- **Bactrim**

Medication stability
Medications don't follow the same rules as on Earth

Impact

Many of the medications in space **would <u>not pass</u> US testing standards**

Ionizing radiation

Trace moisture from within the pill

Production of **reactive oxygen species** & **free radicals**

Oxidative **stress**

Degrades clavulonic acid

Learning points & take aways

Learning points & take aways

- Spaceflight causes **functional immunocompromise**
  - ↓ T-cell function, lymphoid atrophy
  - ↑ **viral reactivation** (HSV, VZV)
  - **Shift in GI microbiome** (↓ normal flora, ↑ gram-negatives)
- **Spacecraft** can have a **very dirty** microbiome
  - **Gram negatives** (Pseudomonas, **Burkholderia**, Serratia), **Candida**, **molds**; even **protozoa & spirochetes**
- Space affects both the humans and the pathogens
  - ↓ convection → diffusion-dependent growth → **stange biofilms**
  - Some become **more virulent** (**gram neg**) but other become **less virulent** (**gram pos**)
- Standard **infection control processes may be less effective**
  - Biofilms + fluid behavior limit sterilization
- **Outer space degrades medications** (radiation + oxidation), making most ↓ **potency over time**; 1 in 12 are not effective

Slides available on hunterratliff1.com/talk/; Citations available via QR code or via the "citations" button on the website