EMERGE

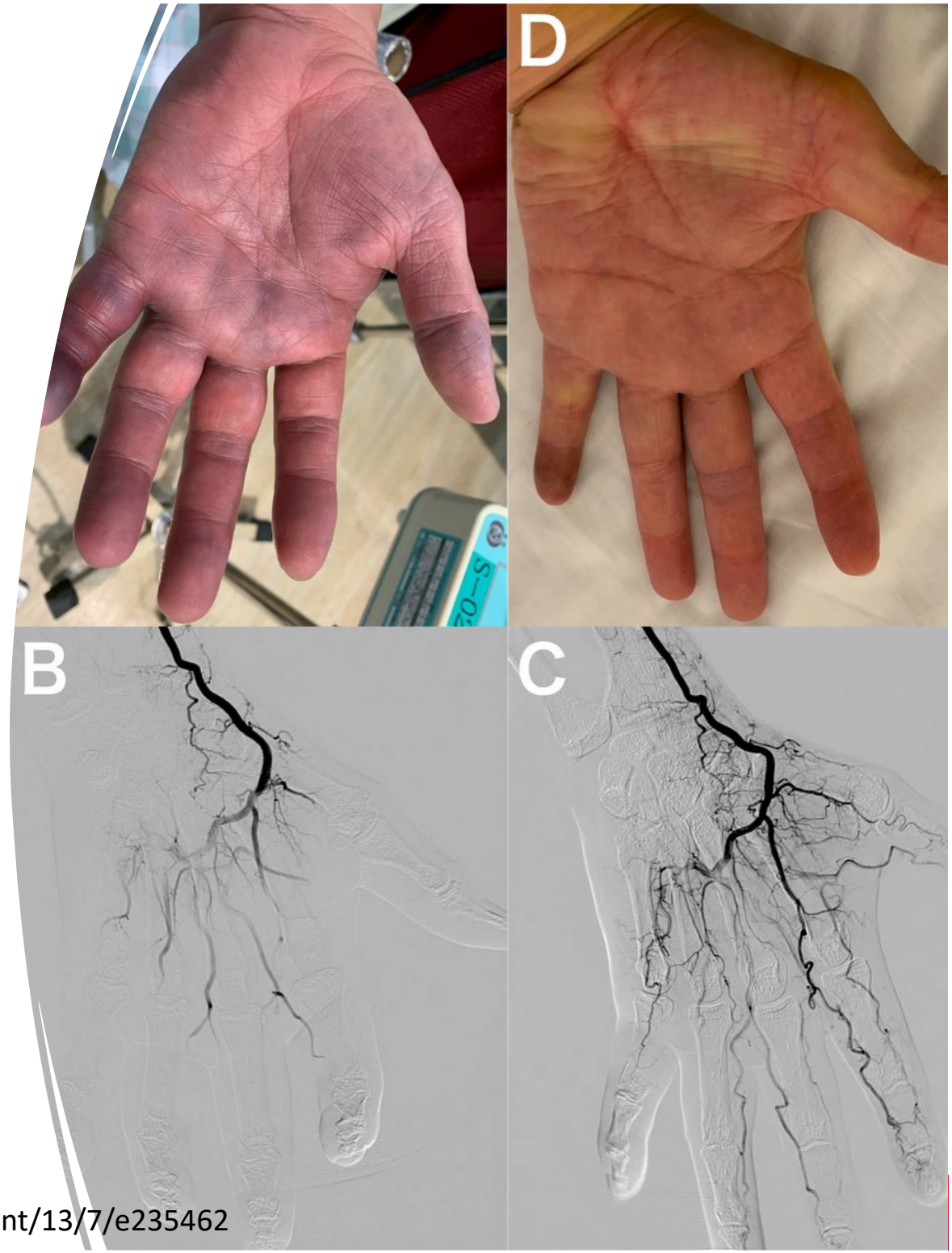
Building a research case for better Acute Aortic Syndrome diagnosis

Matt Reed; RCEM Professor

Rachel McLatchie; ST5 EM trainee

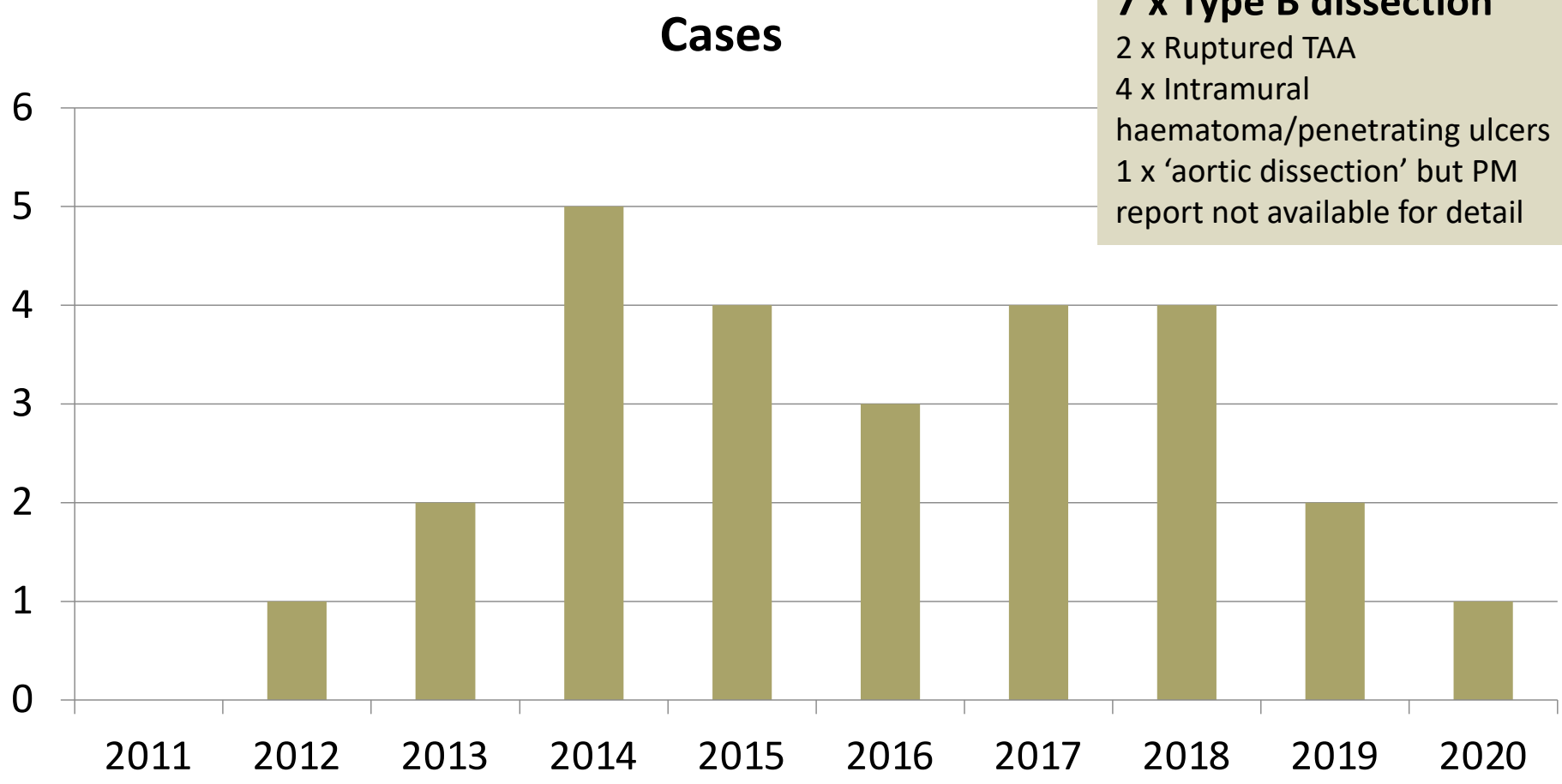
Mr S

- Triage
- 6 hours arm ischemia
- PMH chest pain
- trop negative
- AAS considered
- ED/vascular/theatre…



Reproduced from https://casereports.bmj.com/content/13/7/e235462

Not alone…..
26 RIE/SJH missed cases



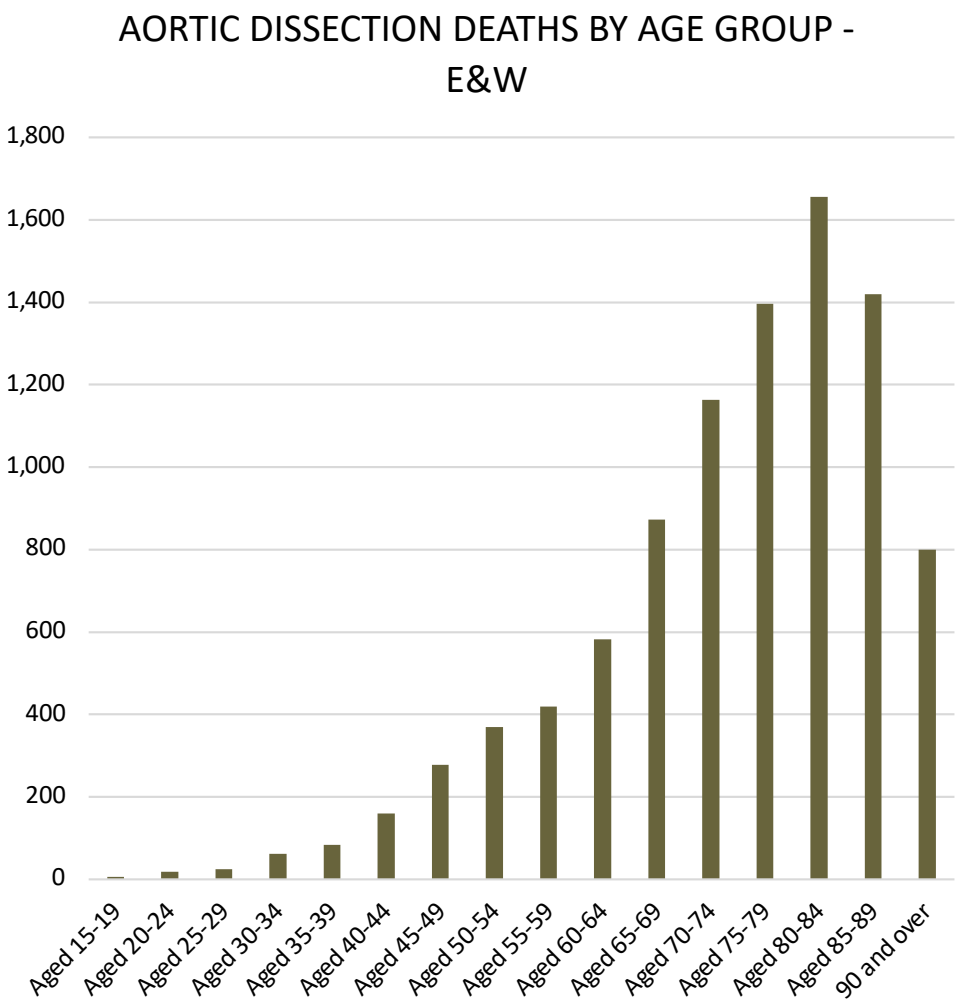
13 x Type A dissection
7 x Type B dissection
2 x Ruptured TAA
4 x Intramural haematoma/penetrating ulcers
1 x 'aortic dissection' but PM report not available for detail

Epidemiology

~4000 cases/yr in UK **[1]**

~1350 death/yr in E&W **[2]**

Males > Females



[1] Erbel R et al. 2014 ESC guidelines on the diagnosis and treatment of aortic diseases. Eur Heart J 2014; 35: 2873-926 [2] ONS Crown Copyright Reserved from Nomis on 9 June 2021; with thanks to Tom Roberts

Diagnosis

- 1 in 4 patients not diagnosed until 24 hours after presenting to ED **[1]**
- ED misdiagnosis rate up to 38% **[2]**
- Common cause of fatality-related negligence claims [NHS Resolution 2022]
- Prognosis best when patients are treated early
- Mortality increases 2% per hour of delay **[3]**

[1] Lovy AJ et al. Am J Emerg Med. 2013; 31: 1546–1550. doi: 10.1016/j.ajem.2013.06.005; [2] Harris KM et al. Circulation 2011; 124: 1911-8; [3] Pape LA et al. Presentation, diagnosis, and outcomes of acute aortic dissection: 17-year trends from the International Registry of Acute Aortic Dissection. J Am Coll Cardiol 2015; 66: 350-8.

Diagnostic challenge

- Chest pain commonest PC (80%) **[1]**
- Back (40%) and abdominal pain not uncommon **[1]**

- 2 million chest/back/abdo pain ED attendances/yr (England) **[2]**
- Overwhelmingly due to causes other than AAS

- Incidence of AAS = 1 in 980 ED patients with atraumatic chest pain **[3]**

[1] Erbel R et al. 2014 ESC guidelines. Eur Heart J 2014; 35: 2873-926; [2] NHS Digital A&E 2021; [3] Alter SM, Eskin B, Allegra JR. Diagnosis of Aortic Dissection in Emergency Department Patients is Rare. West J Emerg Med. 2015; 16(5): 629-31; [4] https://medium.com/personal-growth/surprise-you-are-the-needle-in-the-haystack-ec9c4e318510

Diagnostic challenge

- CT Angiogram (CTA) - high sensitivity and specificity
- Over testing leads to:
  - Diagnostic yields as low as 2% **[1,2]**
  - Significant costs and resource implications
  - Ionising radiation risks
  - CT delays for non-AAS patients
  - Burden of 'incidentalomas'

[1] Lovy AJ et al. Preliminary development of a clinical decision rule for acute aortic syndromes. Am J Emerg Med. 2013; 31: 1546–1550
[2] Ohle R et al. Variation in emergency department use of computed tomography for investigation of acute aortic dissection. Emerg Radiol. 2018; 25: 293–298.

Campaigns

THE AORTIC DISSECTION CHARITABLE TRUST

About Us | Aortic Dissection Explained | Research | Resources | Contact Us | **Get Involved** | **Donate**

Aortic Dissection occurs when there is a partial tear in the aortic wall.

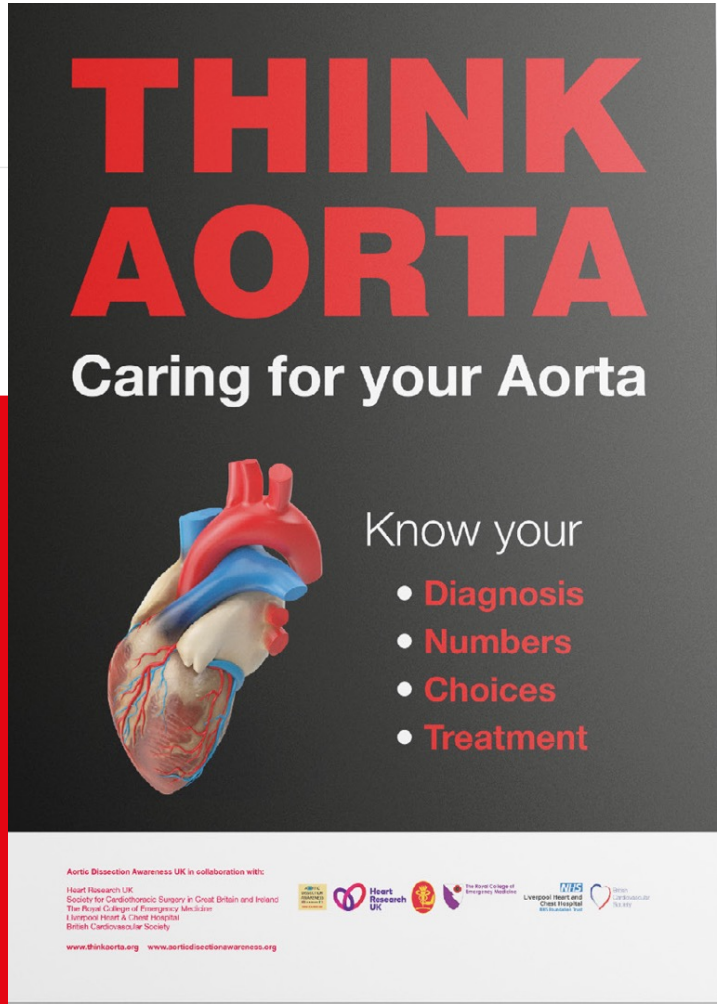
It is a time critical-medical emergency that without diagnosis and treatment, is often fatal.

When diagnosed and treated on time it has a better than 80% survival rate.

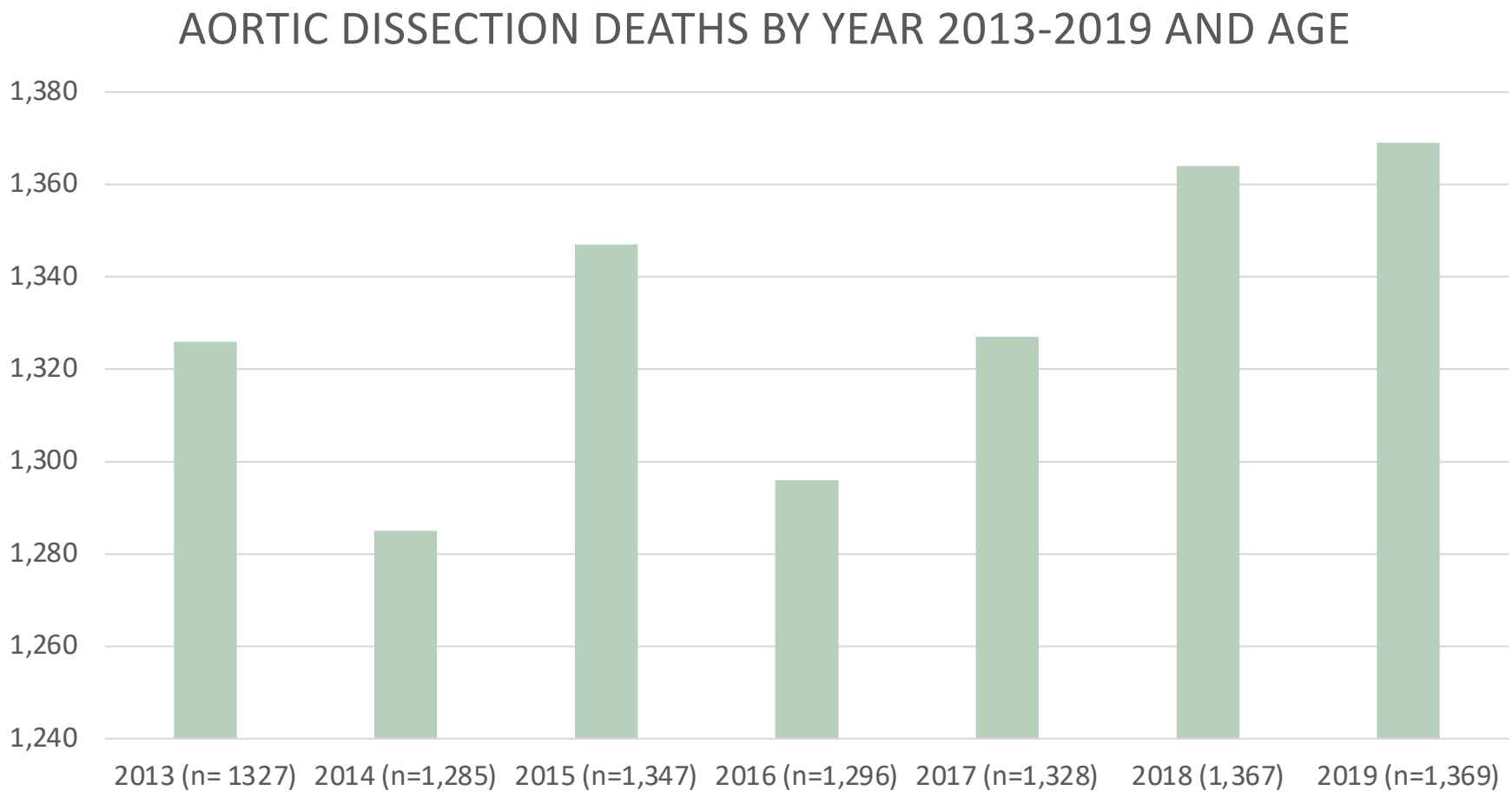
Those who do survive require specialised follow-up and monitoring.

For some patients with aortic dissection, there is a hereditary cause. Relatives of such patients should be screened to ensure that they are not at risk.

The diagnosis, follow-up and screening of patients with aortic dissection are not consistent.



Mortality not improving



Clinical Decision Tools
ADD-RS [1]

Aortic Dissection Detection Risk Score (ADD-RS)		
Predisposing conditions	**Pain characteristics**	**Physical exam findings**
Marfan syndrome	Abrupt onset of pain	Hypotension/shock
Family history of aortic disease	Severe pain intensity	Focal neurologic deficit + pain
Known aortic valve disease	Ripping or tearing pain	New aortic insufficiency murmur + pain
Known thoracic aortic aneurysm		Pain + pulse deficit/BP differential >20mmHg
Recent aortic manipulation		

[1] Rogers et al. Circulation 2011; 123:2213–2218 [2] Tsutsumi et al. EHJ ACC 2020; 9 (3): S32–S39

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Meta-analyses
9 studies
26,598 patients

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ADD-RS ≥1
Sensitivity 94%
Specificity 40%

Miss 1 in 17

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Meta-analyses
9 studies
26,598 patients

ADD-RS ≥1
Sensitivity 94%
Specificity 40%

Miss 1 in 17

ADD-RS ≥2
Sensitivity 46%
Specificity 91%

Miss 1 in 2

[1] Rogers et al. Circulation 2011; 123:2213–2218 [2] Tsutsumi et al. EHJ ACC 2020; 9 (3): S32–S39

D-Dimer [2]

Meta-analyses
16 studies
1,135 patients

[2] Yao et al. J Cardiothorac Surg. 2021; 16(1): 343

D-Dimer [2]

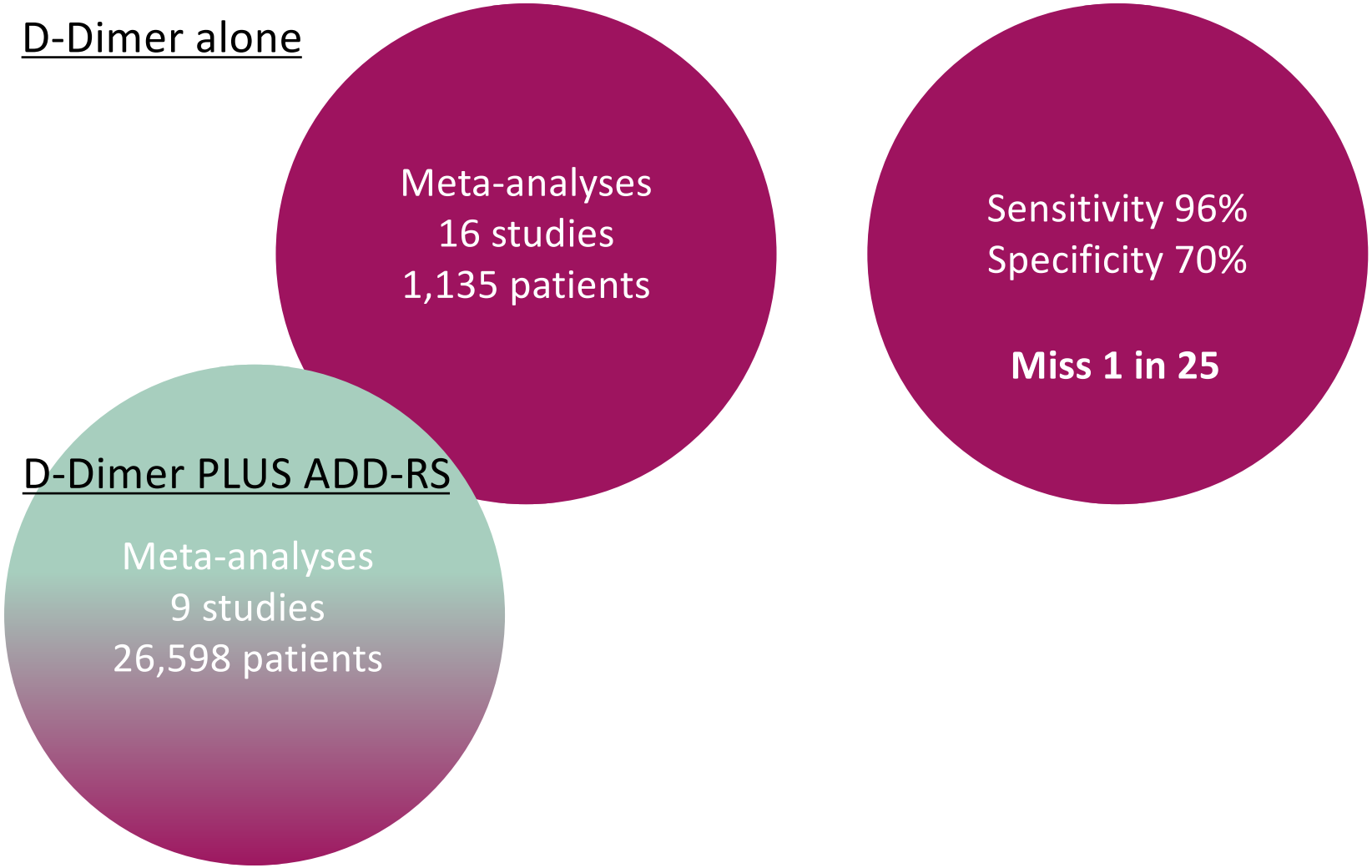
Meta-analyses
16 studies
1,135 patients

Sensitivity 96%
Specificity 70%

Miss 1 in 25

[2] Yao et al. J Cardiothorac Surg. 2021; 16(1): 343

D-Dimer PLUS ADD-RS [3]



[3] Tsutsumi et al; EHJ ACC 2020, 9 (3): S32–S39 https://doi.org/10.1177/2048872620901831

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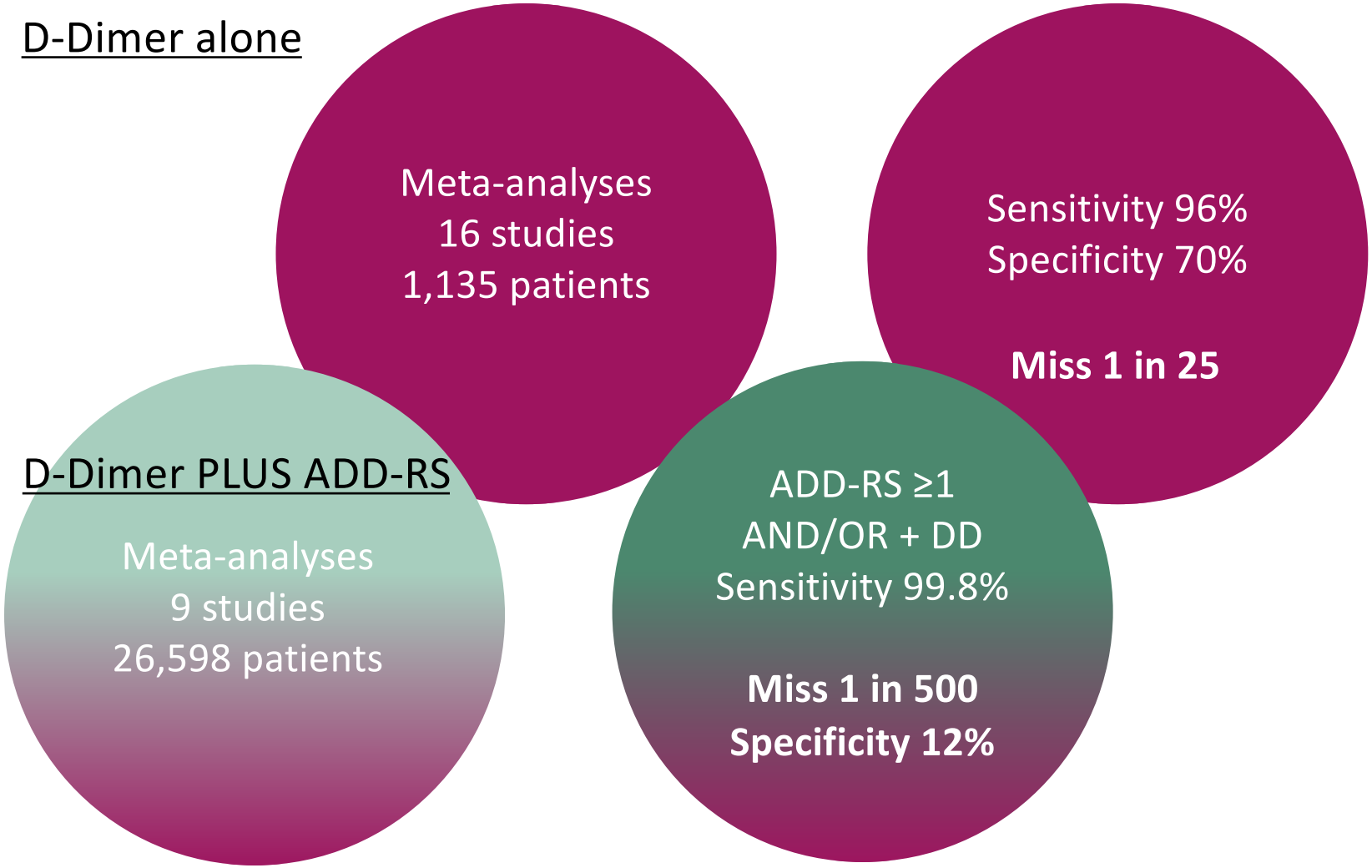

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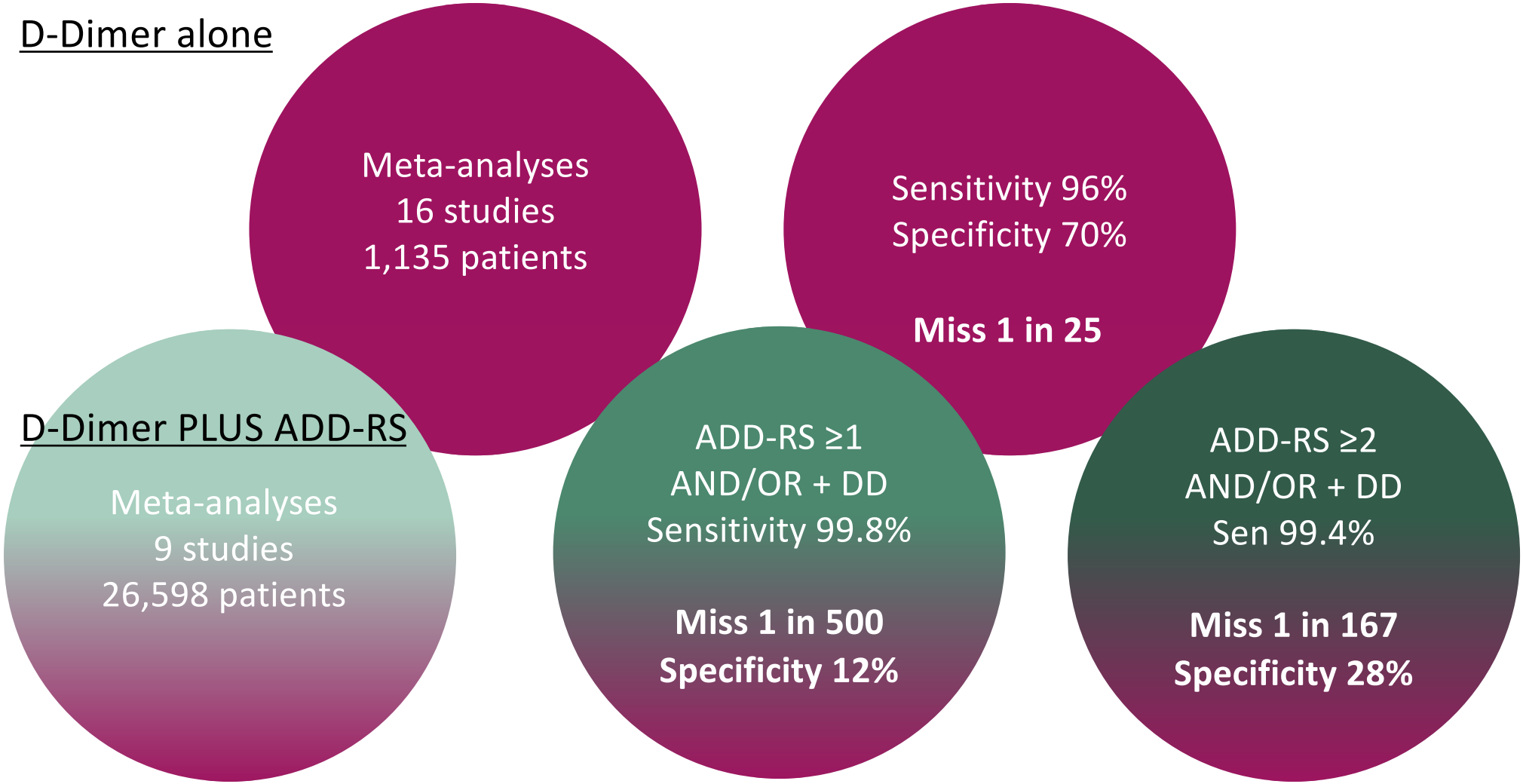

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D-Dimer PLUS ADD-RS [3]

D-D

D-D

There are other CDRs:

Canadian clinical practice guideline CDR [Ohle 2020]

AORTA score [Morello 2021]

All have modest specificity

→ High rate of CTA use

→ Low diagnostic yield of AAS

Maybe appropriate

Effect on CTA resources

[3] Tsutsumi et al; EHJ ACC 2020, 9 (3): S32–S39 https://doi.org/10.1177/2048872620901831

D-Dimer PLUS ADD-RS [3]

D-D

D-D

Canadian guidelines recommend D-dimer for intermediate-risk patients [Ohle 2020]

ESC guidelines recommend D-dimer for low-risk patients [Erbel 2014]

AHA guidelines do not identify a role for D-dimer [Hiratzka 2010]

RCEM Best Practice Guidance – advocate ADD but more research needed [RCEM/RCR 2021]

[3] Tsut

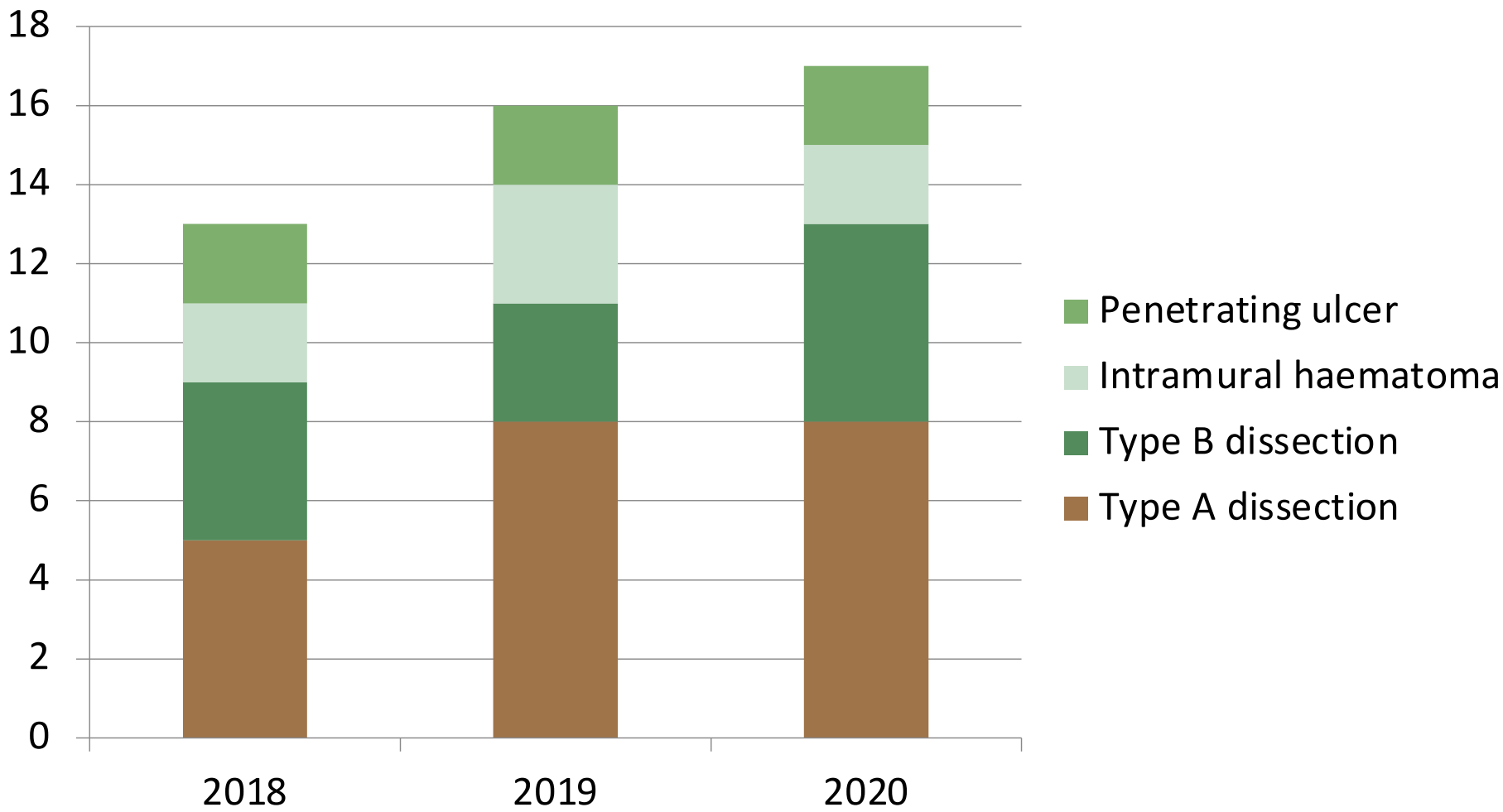
Difficulties with research

- Relatively rare disease
- AAS missed because the clinician doesn't think of the diagnosis therefore how do you include these patients in a study
- AAS doesn't have a single presenting complaint
- Consent – risk of not recruiting unwell patients
- Hawthorne effect
- D-Dimers/CT not routine in all ED patients
- When to suspect it vs what to do once I have suspected it?

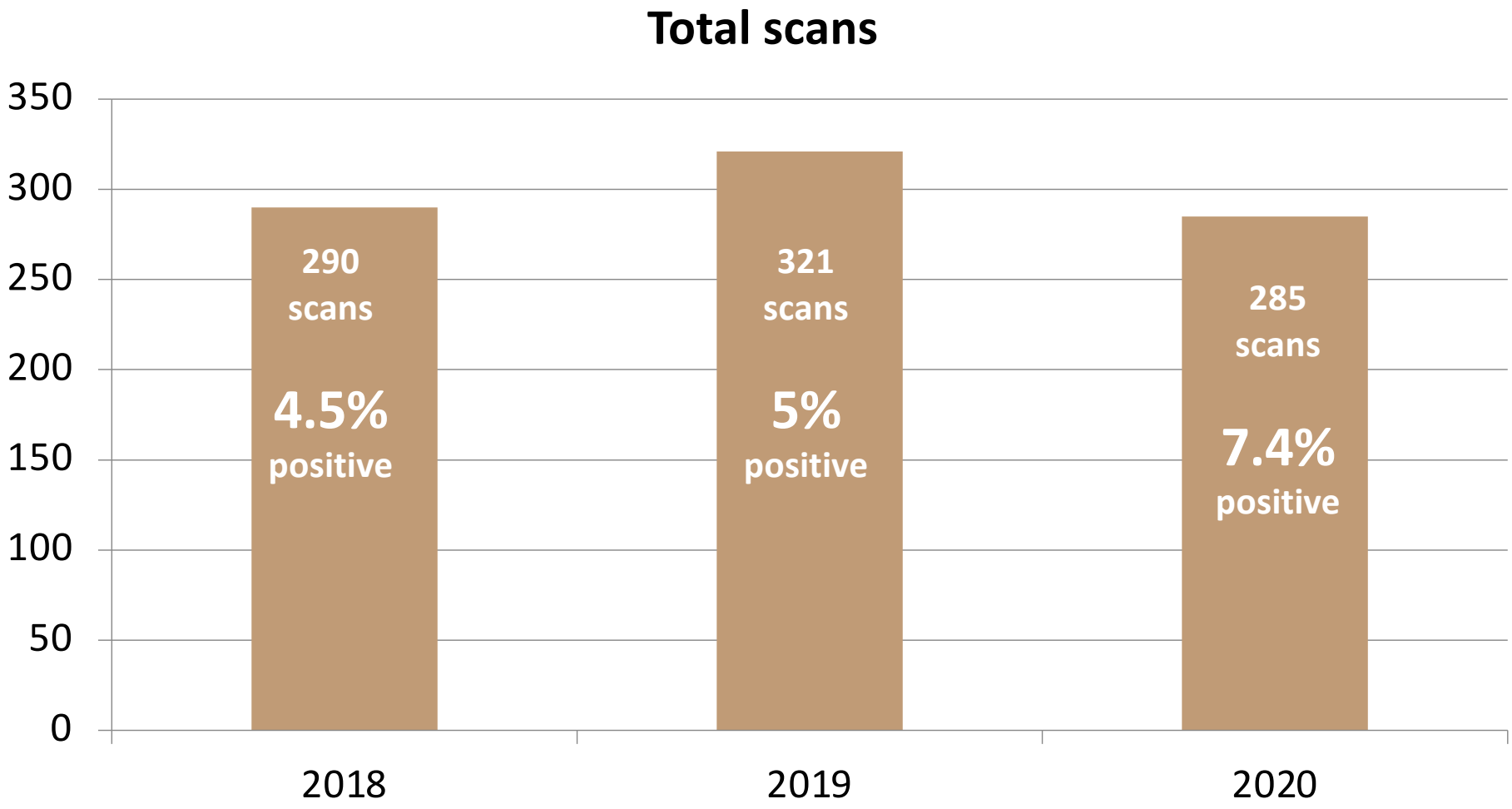
Aortic Dissection Diagnosis Research Group (ADDRG)

- Dr Matt Reed (EM, Edinburgh)
- Dr Rachel McLatchie (EM, Edinburgh, TERN)
- Ms Catherine Fowler (The Aortic Dissection Charitable Trust)
- Richard Parker (Statistician, ECTU)
- Dr Ben Loryman (EM, Sheffield)
- Dr Sarah Wilson (EM, Frimley Park)
- Professor Steve Goodacre (EM, Sheffield)
- Jessica Boyle (Medical student, Edinburgh)
- Mr Graham Cooper (Cardiothoracic surgeon, Sheffield)
- Dr Rob Hirst (TERN lead)
- Alicia Cowan (Physician Associate Lead)
- Nicola Freeman (EMERGE nurse)
- Professor Robert Hinchliffe (Vascular surgeon, Bristol)
- Dr Steven Thomas (Radiologist, Sheffield)
- Charlotte Davies (Lewisham and Greenwich)
- Aakash Gupta (EM Trainee, Edinburgh)
- Salma Alawiye (EM Trainee, Edinburgh)

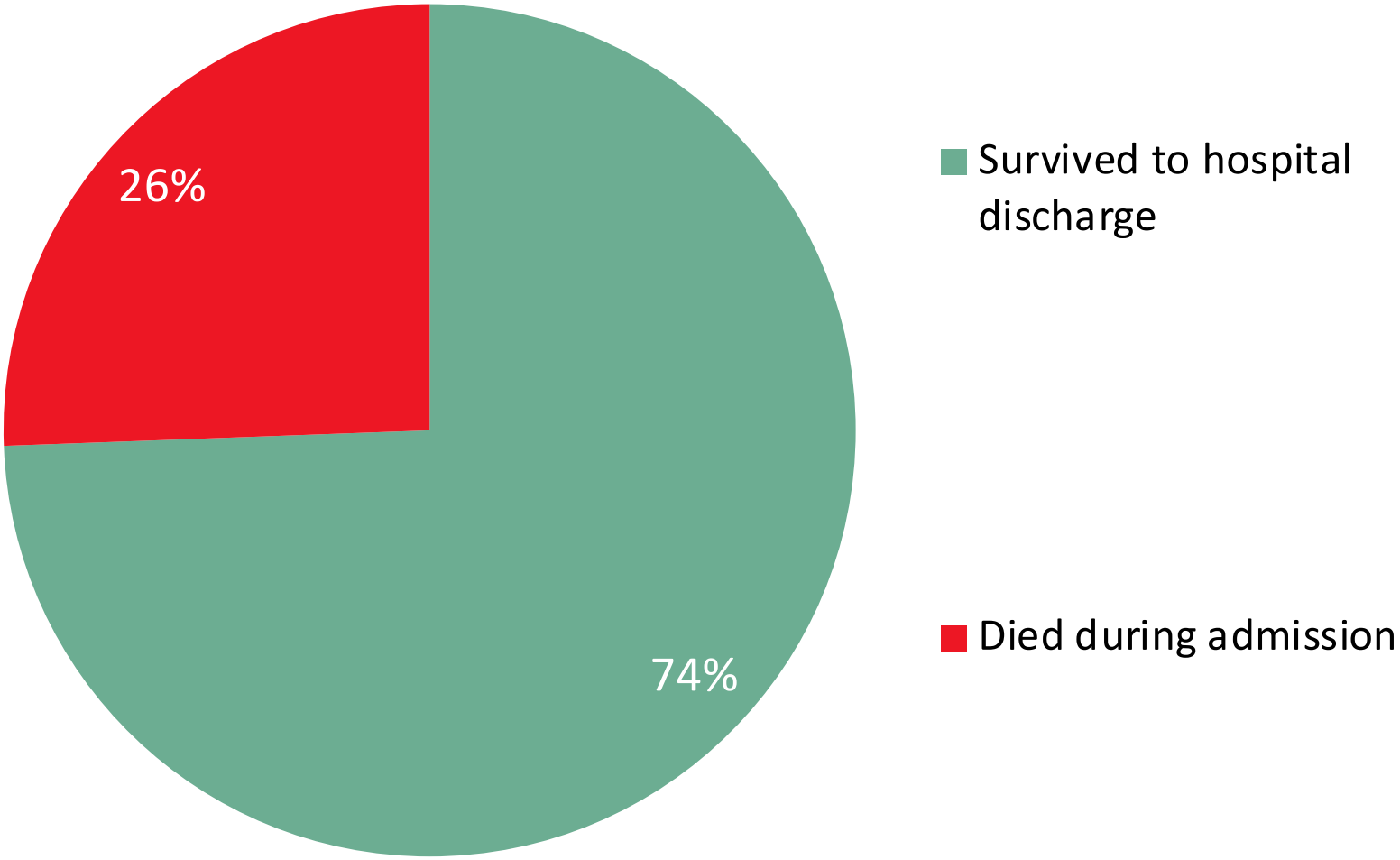
Number of cases AAS per year
(RIE ED/SJH ED, NHS Lothian)



How many CT thoracic aortas are we doing in ED looking for AAS?



Outcomes
(2018 - 2020 ED AAS diagnoses - local)



Retrospective review of missed cases 2011-2020

(3 sites; NHS Lothian, Frimley Health NHS Foundation Trust)

EMERGE

Royal Infirmary of Edinburgh & St Johns Hospital Livingston (NHS Lothian)

26 cases

M&M/Complaints/PM reports

11 cases included

10 delayed in-hospital diagnoses

1 post-mortem diagnosis

CTs requested downstream from ED with finding of missed diagnosis of AAS

1376 CT requests reviewed

1361 excluded

15 cases included

Wexham Park Hospital (NHS Frimley Health Foundation Trust)

17 cases

M&M/Complaints/PM reports

5 cases included

3 delayed in-hospital diagnoses

2 post-mortem diagnos

CTs requested downstr

ED with finding of m

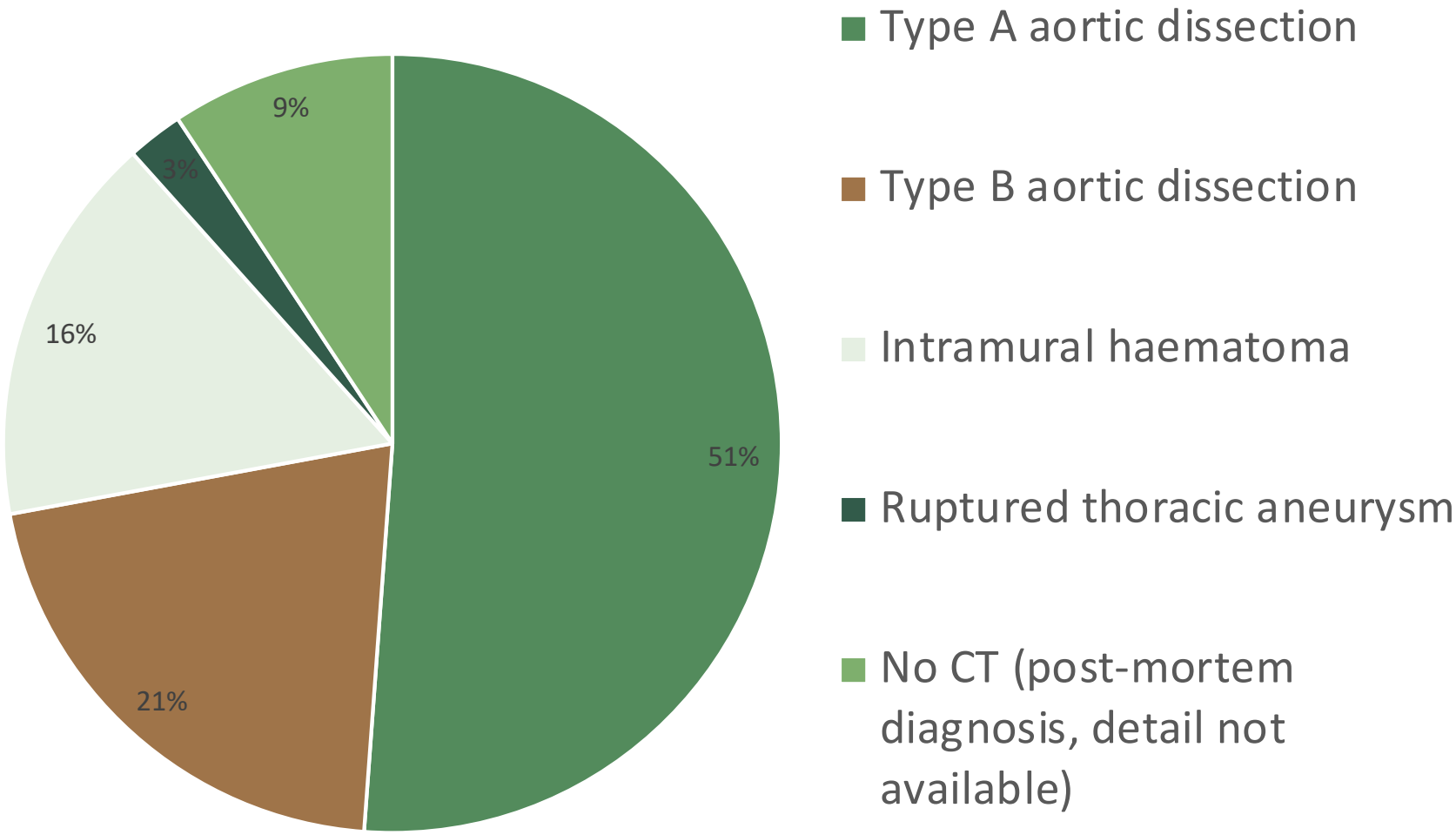
diagnosis of AAS

12 cases included

43 cases

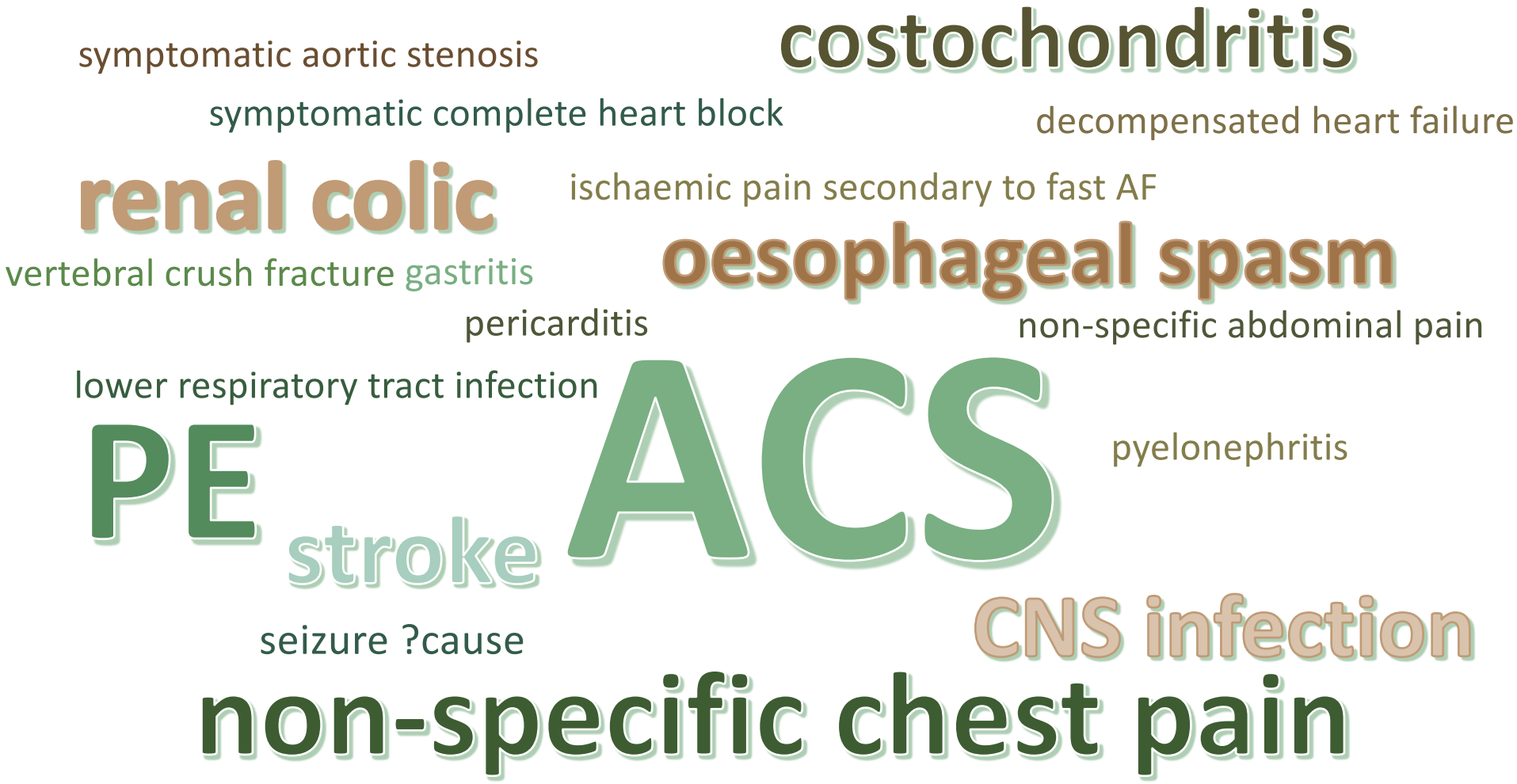
Retrospective review of missed cases 2011-2020

Diagnoses



Retrospective review of missed cases 2011-2020

Alternative presumed diagnoses



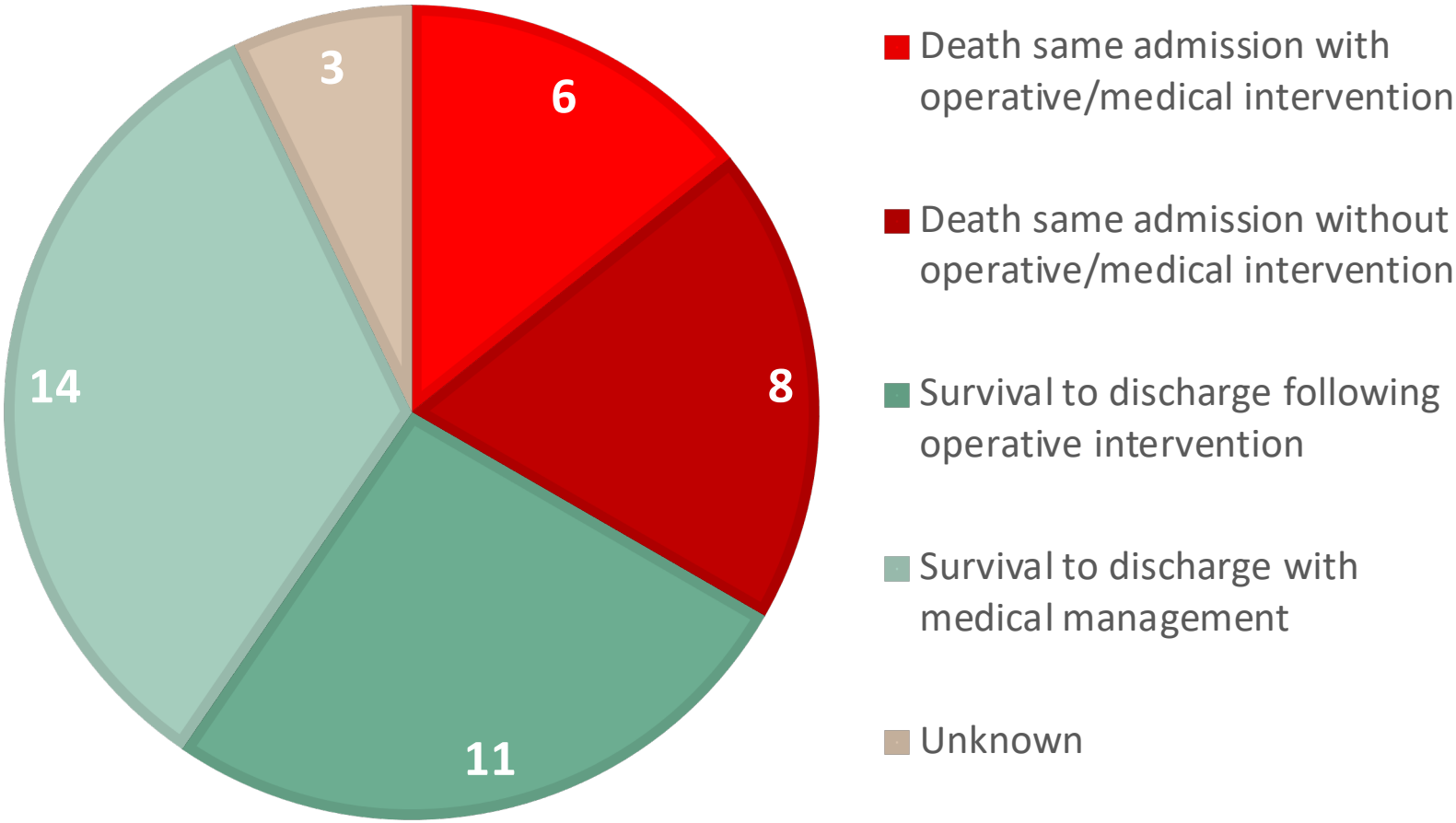
Retrospective review of missed cases 2011-2020

Reasons we missed it

No evidence of consideration of AAS in differential diagnosis	31
Satisfied by alternative presumed diagnosis	19
Satisfied by exclusion of ACS	6
Diagnosis of AAS considered but not pursued as reassured by absence of radial-radial delay or BP differential	5
Diagnosis of AAS considered but not pursued as reassured by normal CXR	3
Diagnosis of AAS considered but not pursued due to atypical symptoms	1
Diagnosis of AAS considered but not pursued as reassured that pain had settled	1
Diagnosis of AAS suspected but CT misreported as being normal	1
Did not recognise widened mediastinum on CXR	1
Unknown (limited notes available)	2

Retrospective review of missed cases 2011-2020

Patient outcomes



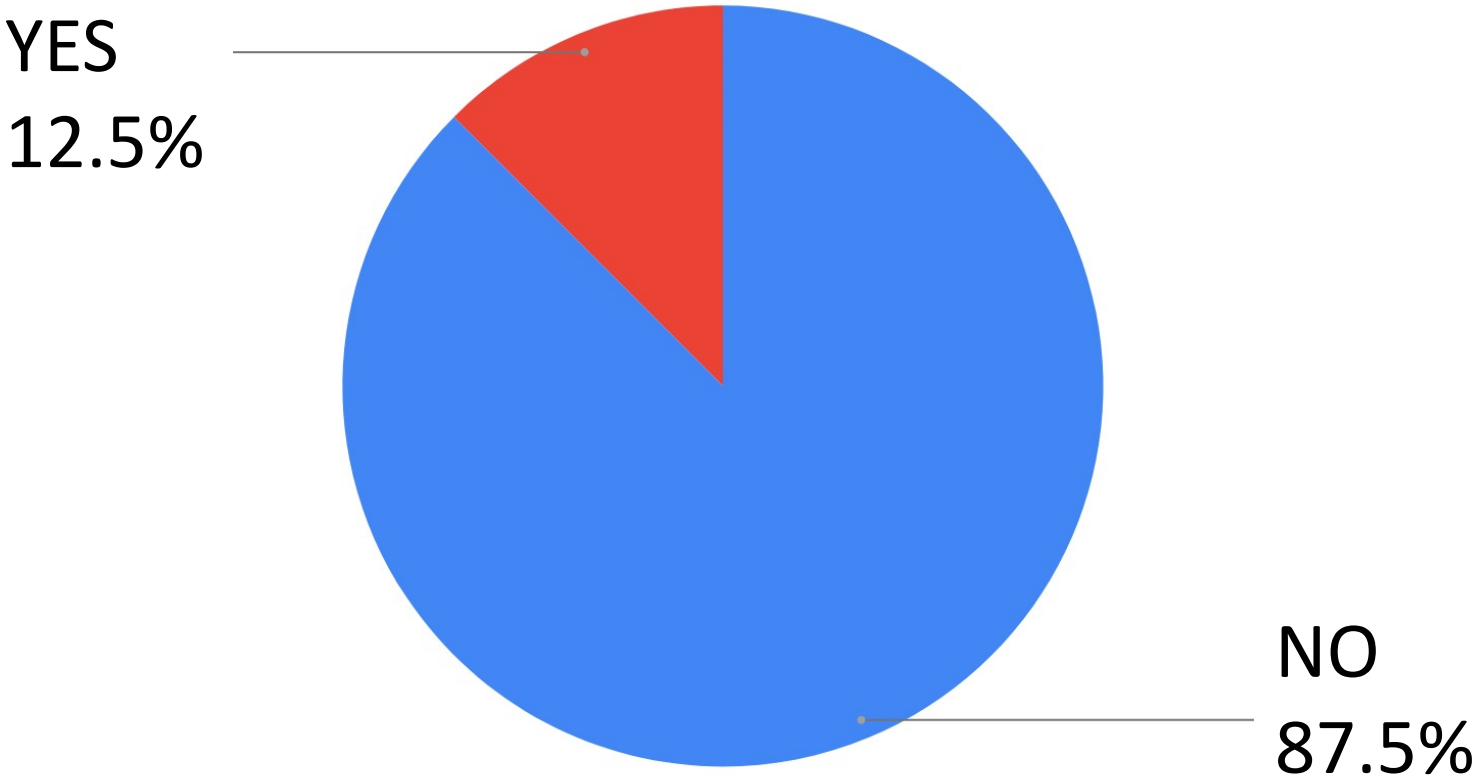
Clinician survey of practice (UK)

- Dec 2021 – Jan 2022
- 56 UK EDs responded

- 21% manage Type A dissections on site
- 54% manage Type B dissections on site

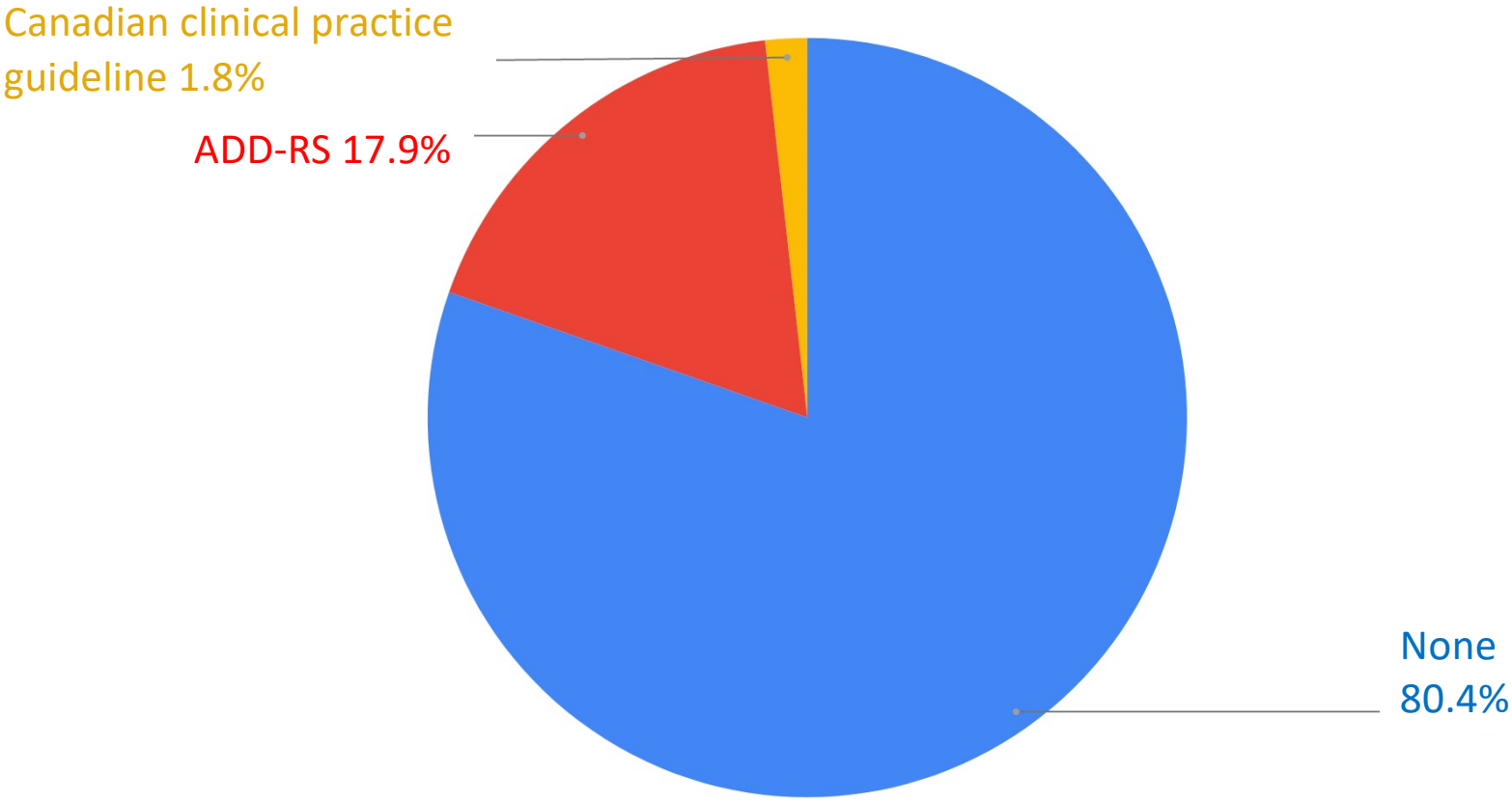
Clinician survey of practice (UK)

Does your ED have a formal pathway for work-up of potential AAS?



Clinician survey of practice (UK)

Do you routinely use any of these decision-making tools in your consideration of investigations for AAS?

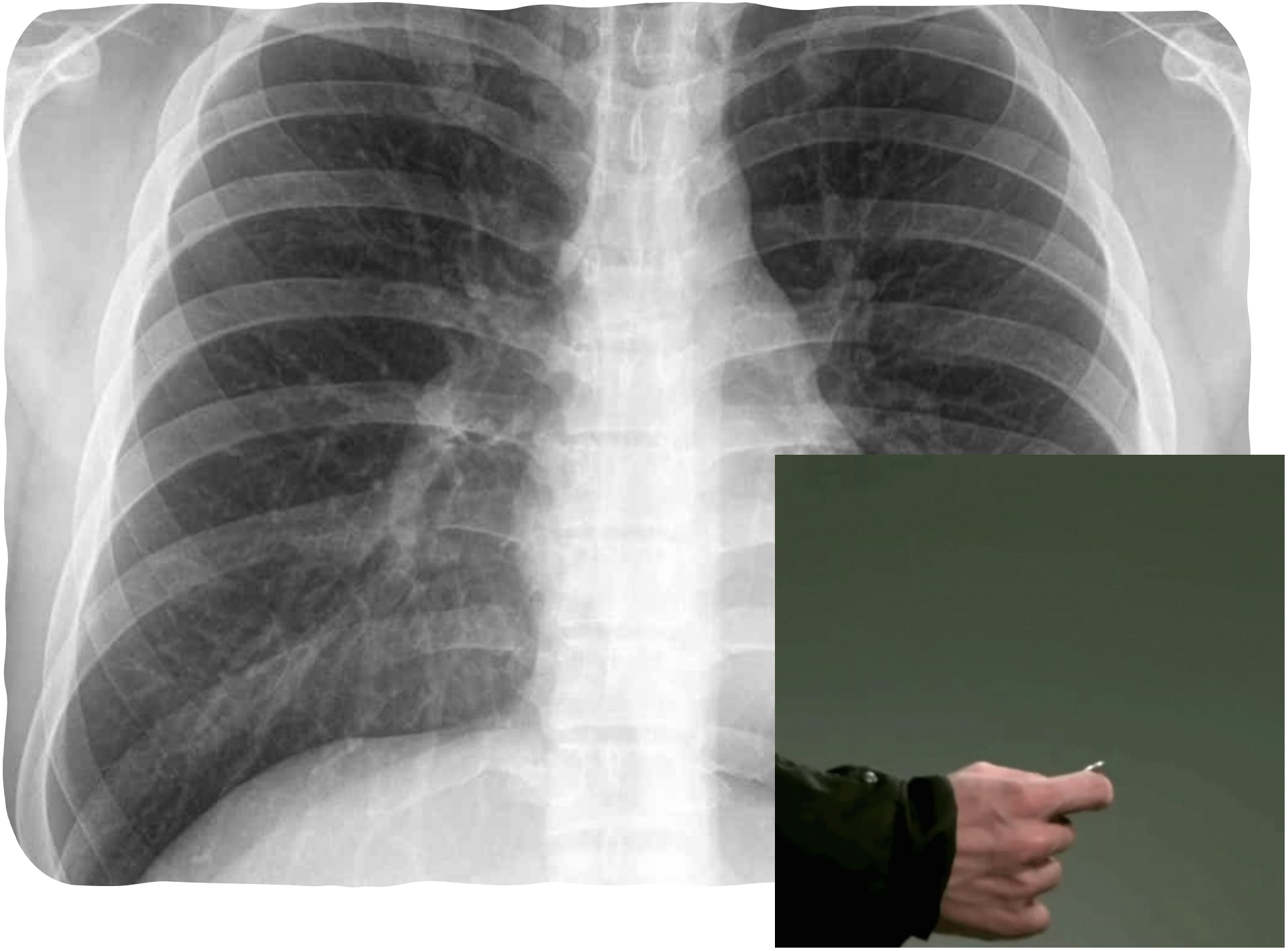


Clinician survey of practice (UK)

47 EDs were **interested in involvement in further related research**

Ongoing research plan

- Evidence synthesis / Systematic review
- **DAShED** - Phase 1 prospective observational cohort study of all people attending the ED with symptoms of AAS, including new-onset chest, back or abdominal pain, syncope or symptoms related to malperfusion
- Phase 2: Interventional external validation study
- Phase 3: Interventional cluster/stepped wedge randomised controlled trial



Thank you

Emergency Medicine Research Group Edinburgh

Emergency Department, Royal Infirmary of Edinburgh

51 Little France Crescent, Edinburgh, EH16 4SA

Website: emergeresearch.org

Twitter: @emerge_research

Email Address: emerge@nhslothian.scot.nhs.uk