UCL/RSS Symposium on Teaching Statistics in Higher Education (RSS, Errol Street, 3 April 2019)

Progression towards open access environments in the teaching of statistics to non-specialists in medicine and allied health sciences and promoting curriculum reform through a practitioner-focused evidence base

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SUPPORTING UNDERGRADUATE MEDICAL STUDENTS ENGAGED IN SHORT-TERM CURRICULAR RESEARCH PROJECTS

- In 2016, I launched the open access WordPress site StatsforMedics for presenting and further developing my longstanding statistics knowledgebase resources.
- Homepage: https://medstats.mvm.ed.ac.uk/
- Host: University of Edinburgh (UoE) Medical School
- 45849 hits

KEY DRIVERS

- Migration of electronic medical curriculum over to Blackboard Learn.
- WordPress has better design capabilities.
- Opportunity for autonomy in creation, management and maintenance of resources.
- The need to deliver a site with wide coverage in medical statistics topics while catering for the bespoke needs of the individual student researcher.

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StatsforMedics

Search facility

WELCOME PAGE | SCOPE AND USE OF SITE | TABLE OF CONTENTS | ESSENTIAL PRIOR LEARNING | QUESTIONNAIRE DESIGN

FREQUENTLY ASKED QUESTIONS ON STATISTICAL METHODS FOR PRESENTATION AND ANALYSIS OF DATA | REPORTING GUIDELINES | ABOUT THE AUTHOR | BOOK AN APPOINTMENT | ACKNOWLEDGEMENTS

The WordPress site for supporting undergraduate medical student learning in statistics for short research projects

Boundaries need to be set

SCOPE AND USE OF SITE

The content within these pages is designed specifically for use by undergraduate medical students who are considering use of statistics for short-term research projects. This is with a due understanding of appropriate learning boundaries in terms of statistical aspirations. Correspondingly, many of the more advanced or esoteric procedures which I use in

PERMISSIONS

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Recognition of the student voice: student engagement through partnership

- Supervision of Year 5 Student Selected Component (SSC5b) peer-assisted learning project
- Comprehensive review by student of StatsforMedics involving recommendations for making site content more user-friendly
- Student developed introductory navigational video for StatsforMedics - see Welcome page

Opportunities for more interaction with students arising from break-out session at HEA Annual Conference 2017 and BCME9 2018

- Twitter account StatsforMedics: weekly announcements about new content or highlighting existing content

- Options to login via Twitter and LinkedIn

- Provision of student suggestions form – separate sections for functionality and statistical content to be included in StatsforMedics

- Plans for outreach work with schools!

Update further to trial and error

- Lack of engagement with Twitter account for updates and student suggestions form if highlighted in introductory statistics lecture.
- I have observed very similar results with discussion boards for research skills in general.

Some background …

- Undergraduate medical students do not tend to prioritize statistical learning;
- They are competitive and ambitious and continually need incentives – “What’s in it for me?”

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Possible ways forward –for discussion time?

- Creating activities with time constraints for engagement with Twitter - discuss

- Circulate email

  at end of module inviting completion of suggestions form

Maths, Stats & OR (MSOR) Network*
Funded Project: Statistics in medicine: a risky business?

August 2007 – August 2008

Partner project on improving Motivation and Retention in the Learning of Statistics funded by University of Edinburgh (UoE) Principal's eLearning Fund

(3 x 1-year projects, 2005 - 2008)

Principal Investigator: Margaret MacDougall
Project Partner: Jackie Aim (eLearning Developer, UoE)

*This network was a subject centre of the old Higher Education Academy (HEA).

Key outputs

- 3 CALs* - Self-paced learning resources for enhancing conceptual understanding of statistics and promoting sound interpretation of risk estimates for clinical decision making
- Now open access
- Provided within StatsforMedics via sister site **Medical Statistics CALs**

*CAL: **C**omputer **A**ssisted **L**earning object

CAL themes

- Summary statistics, Normal distributions and the confidence interval for the sample mean (CAL 1)
- Testing for a difference between two populations (CAL 2)
- Risk (CAL 3) – some features to follow …

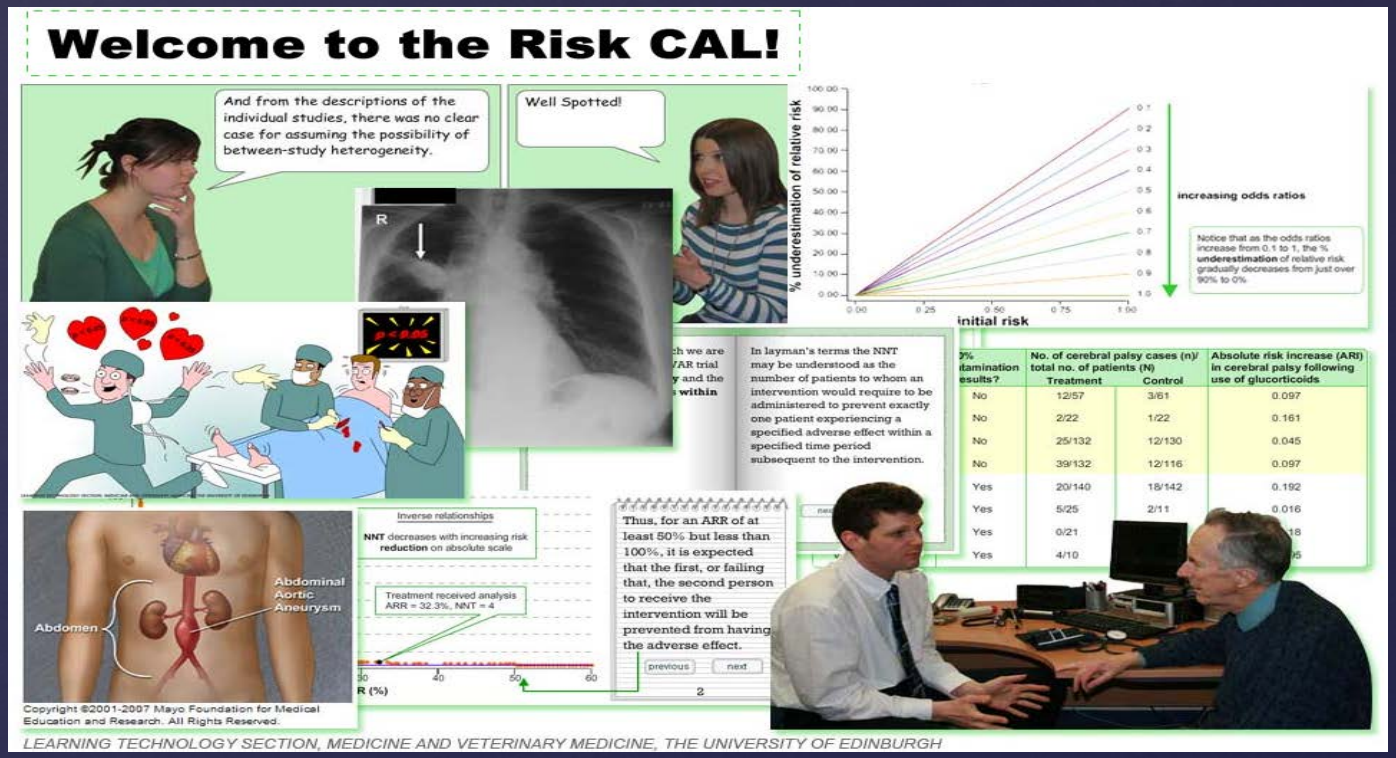
*CAL: **C**omputer **A**ssisted **L**earning object

Risk CAL features

Designed to empower learners to:

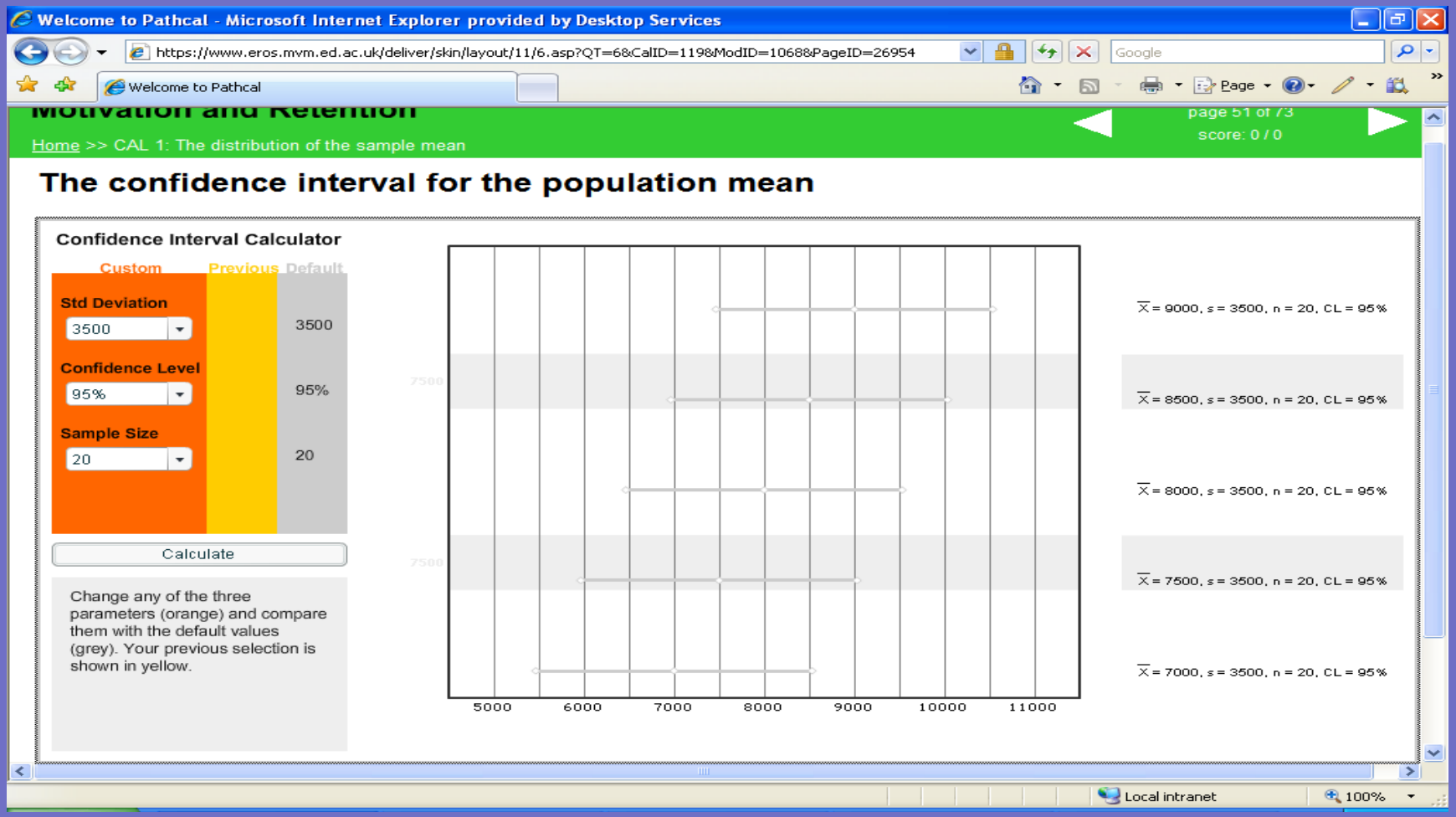
- make the right choices from the range of available risk estimates in Medicine
- perform their own calculations to evaluate risk
- assess the validity of the content of medical literature prior to communicating medical or surgical risks to patients
- avoid misuse of statistics within the context of their own working practices on graduation

The 3 CALs feature a variety of types of learning object and approaches to promote effective engagement and flexible learning.



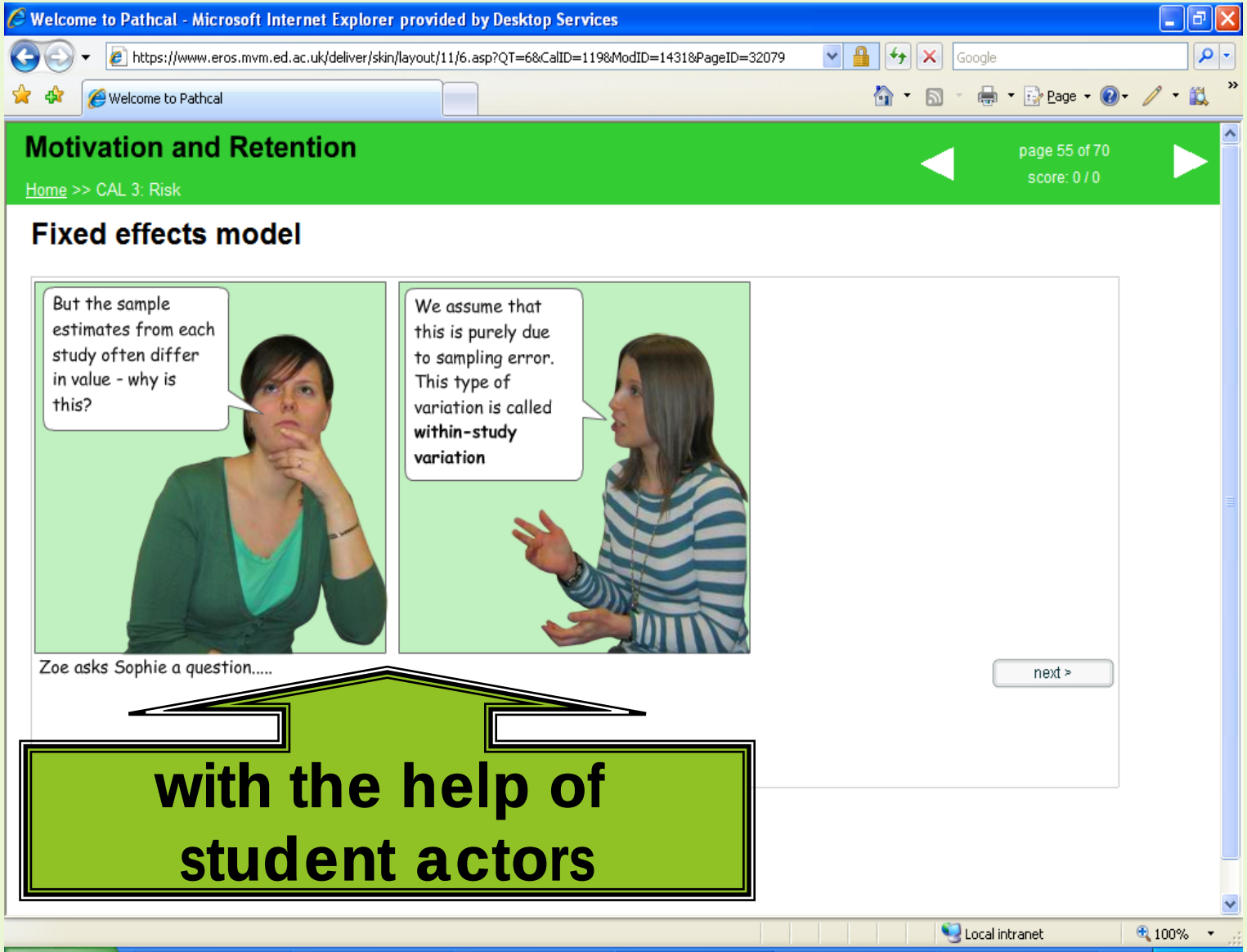
This includes sensitivity to the learning styles of students with Specific Learning Difficulties.

Opportunities to explore: Confidence interval calculator



Follow-on examples and exercises provided in this and many other cases

Empathy with potential areas of confusion



Inclusion of spotlight books to suit different learning styles

Number Needed to Treat (NNT)

A further risk notion which you will come across in your career is the number needed to treat (NNT). The number need to treat can be expressed in terms of the Absolute Risk Reduction (ARR) as

$$NNT = \frac{1}{ARR}$$

You way wish to pause here to learn more about the NNT by turning to the study guide **Splotlight on the Number Needed to Treat** through clicking on the button , below. Alternatively, you can skip to the next page to get a broad overview of the bigger picture and return here later for a more focused read. Please note that the material in this guide constitutes **essential learning** for the practice of Evidence-Based Medicine, but you are free to choose which of the above two approaches to learning is optimal for you.

5.1. A deeper approach to learning about the NNT: an essential read

option to continue

option to access book

view book

LEARNING TECHNOLOGY SECTION, MEDICINE AND VETERINARY MEDICINE, THE UNIVERSITY OF EDINBURGH

Go to next page

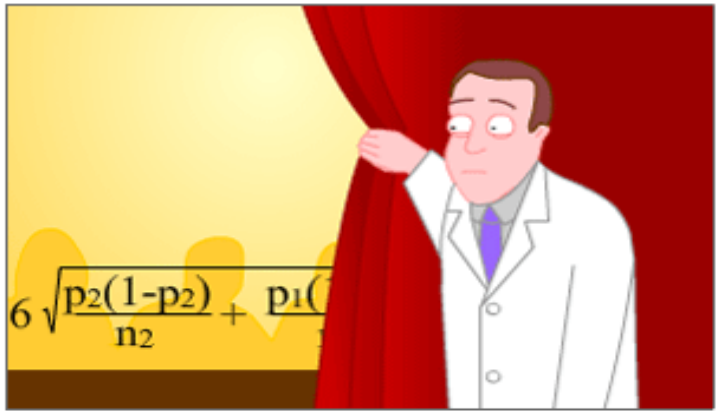
Stop by for more depth versus obtain the bigger picture first

Optional learning

Use of 'Want to check the technical details?' boxes

But how do we obtain the confidence interval for the NNT?

It can be shown that the 95% CI for the ARR is (-0.054, 0.156).



Want to check the technical details?

See the formulae and calculations used
in the derivation of the 95% CI for the ARR

(Link opens in a new window)

As the NNT is the reciprocal of the ARR, it would *seem* to make sense to take the reciprocals of the confidence limits for the ARR.

Let's try this idea!

Go to next page

Links to StatsforMedics to support putting theory into practice with own project data

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Medical statistics in practise - getting engaged with your data!

With these warnings in place, you will ultimately want to learn about calculating relative risks and odds ratios using the statistical package SPSS and to expand your knowledge on presentation of your findings. There are a number of additional resources available to you for this purpose via StatsforMedics. Please enter the search term

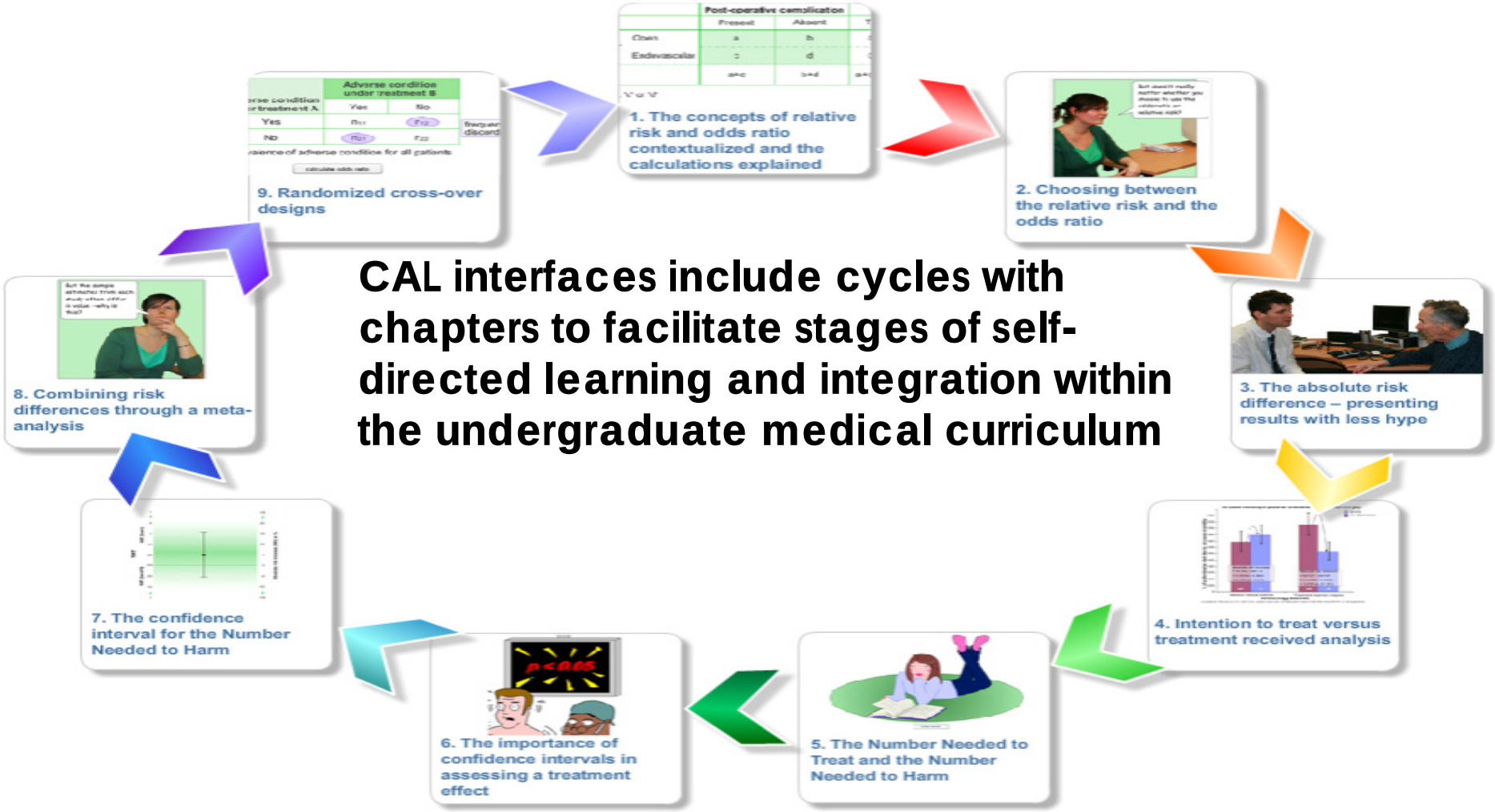
odds ratio

or

relative risk

into the StatsforMedics search box after logging in and then opt for the second link in the list of search returns!

CAL interfaces include cycles with chapters to facilitate stages of self-directed learning and integration within the undergraduate medical curriculum



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My personal perspective on introducing more statistics into the undergraduate medical curriculum

But what do medical graduates have to say based on their own clinical practice?

Funded interdisciplinary project

Preparing medical students for self-directed learning in statistics: What should we expect of tomorrow's doctors?

Principal aim: to define a statistics curriculum for medical students which empowers them to evolve into self-directed learners in statistics

Details of PTAS project

Collaborators – all experienced in educational research or course development

- 1 statistician as Principal Investigator
- 3 clinicians
- 1 learning technology specialist
- 1 expert on use of the package R for multiple imputation of missing data

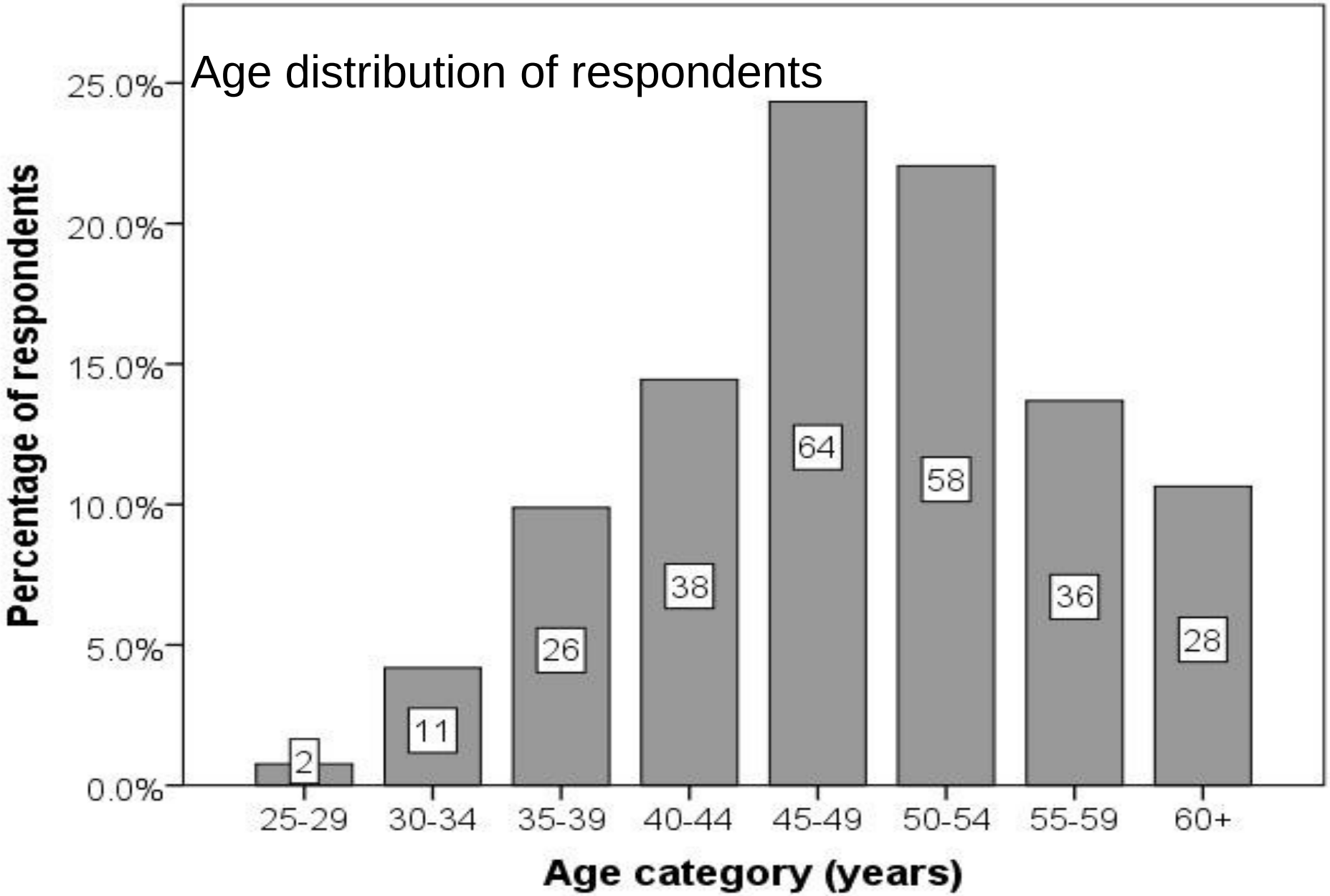
Details of PTAS project

- Involvement of graduate clinicians and undergraduate medical students through a variety of feedback mechanisms
- **Focus of this presentation**: comprehensive survey of **medical graduate** views on statistical learning needs for clinical practice

Details of PTAS project

- Target population: all medical graduates with prior or current experience as educators of UoE medical students
- Aim of survey: to identify statistical competencies for ensuring thorough preparedness of medical graduates for clinical practice
- Period for data collection: July 2013 to August 2014

Response rate: 60.2% (278/462) representing 321 specialties



Key task for respondents

Based on their own experiences of clinical practice: to identify those competencies in statistics and probability that medical schools need to provide within the undergraduate medical curriculum to ensure thorough preparedness of their new medical graduates for clinical practice.

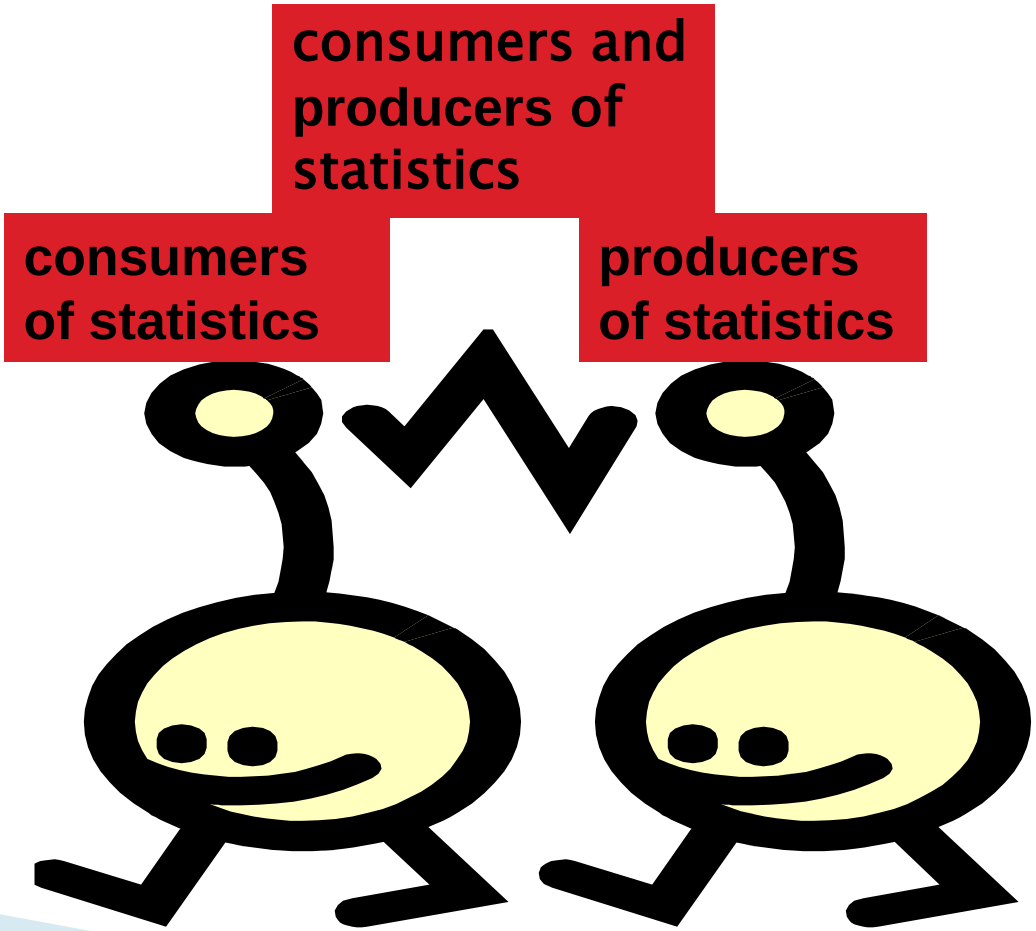
Question style

- Respondents presented with drop-down lists of competency categories for each of 52 topics in statistics and probability
- 2 of these categories involved the requirement to **apply** (practise) statistics
- Respondents also invited to suggest what was missing from list of topics in statistics and probability

Different models of student learning of statistics as non-specialists

Underlying response categories

- understand the theory only
- practise:
  carry out the procedure or calculate the statistic(s) using appropriate data
- both of the above



Presentation of data

- topics in statistics and probability ranked in descending order of magnitude according to the percentage of participants for each topic who chose a response option which included practise

- odds ratios and corresponding 95% CIs used to compare odds of choosing response option of the above type for 51 topics in statistics and probability versus critical appraisal

Viewpoint from previous study on what undergraduate medical students need to learn

"It was felt that medical statistics courses should focus on critical appraisal skills rather than on the ability to analyse data."

Astin J, Jenkins T, Moore L (2002) Statistics in Medicine, 21:1003–1006

Study design: opinion piece based on the views of two undergraduate medical students from the University of Bristol

Key findings of PTAS study

- Evidence gleaned for the need to understand the theory **and** to practise statistics

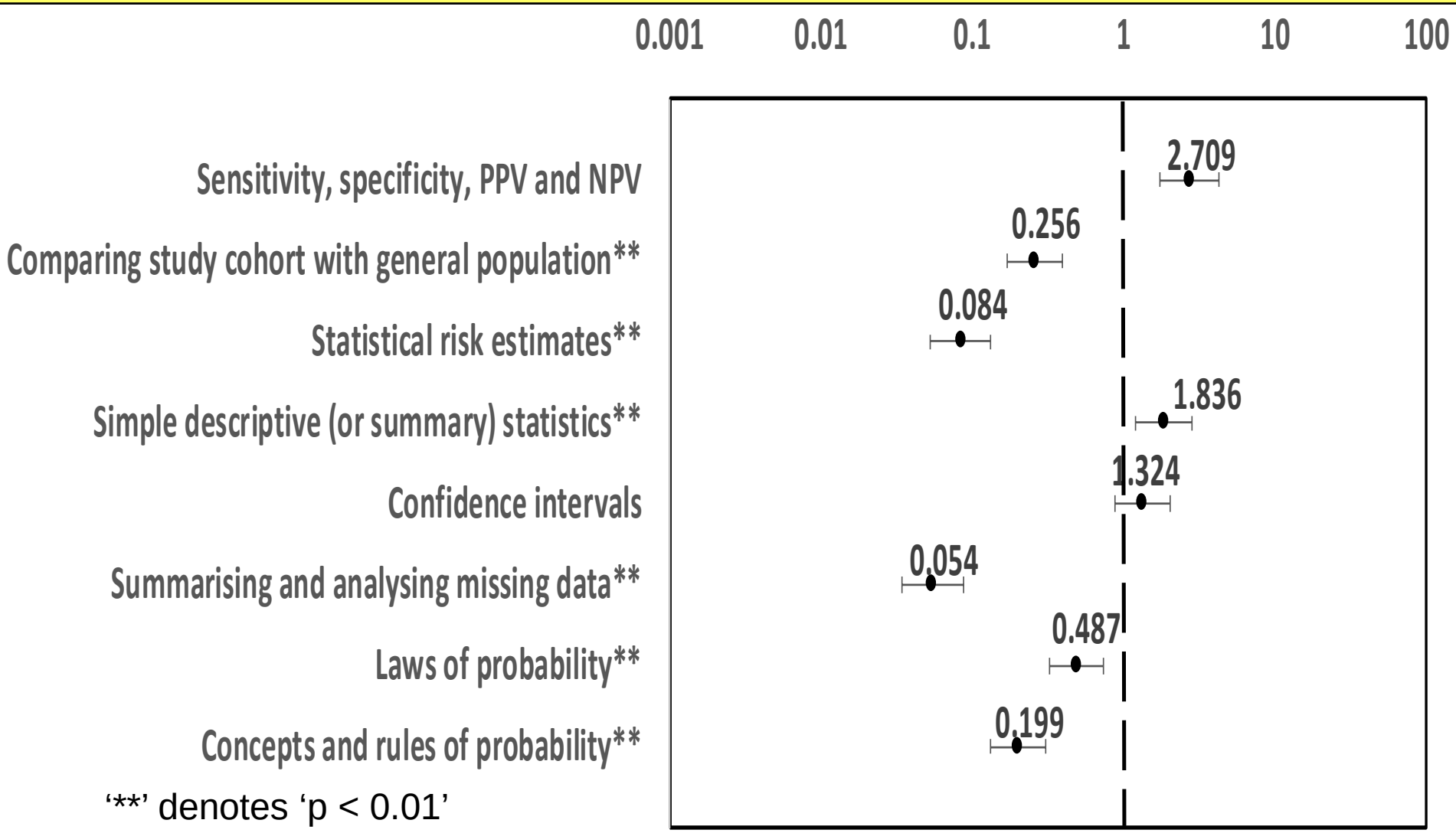
- For 38/52 topics in statistics and probability, at least 25% of respondents identified the practise of that topic as important for clinical practice

- **nature of employment** and **topic in statistics and probability** were found to be highly significant predictors of a response which included practise ($(F = 3.777, p = 9.19 \times 10^{-4})$ and $(F = 45.834, p = 0)$, respectively).

A few interesting findings on the practise of statistics

- Most highly ranked topic : Graphical presentation of data
- Least highly ranked topic: Tests of homoscedasticity (or, ‘equality’ of variance)
- Diagnostic statistics and confidence intervals ranked much more highly than hypothesis testing and conducting ANOVA

odds of positive response for listed topic versus critical appraisal in relation to the practise of statistics

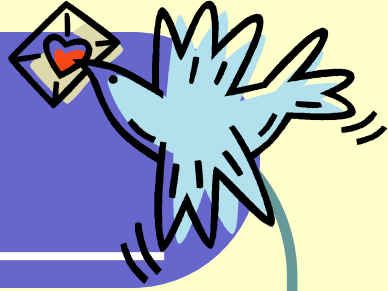


'**' denotes 'p < 0.01'

A few interesting findings on the practise of statistics

- Most popular topic for ‘understand the theory only’ (70.5% of respondents): *cross-over trials*
- Free text data on ‘what’s missing’ led to identification of ideas for approaches to learning
- Example: making conceptual distinctions – e.g. between tests for parametric and non-parametric data or different types of risk estimate

Take home messages



- The model of medical graduates as mere consumers of statistics is oversimplified

- Learning opportunities for carrying out statistical procedures and calculations across a wide range of topics in statistics and probability should be introduced into the Edinburgh MBChB curriculum.

Future work

- Use of response data to define priorities for topics in development of suite of statistics modules
- Provide UG medical students with choice in selection of these modules to satisfy their personal and professional aspirations
- Extend uptake to include CPD and online distance learning for health scientists

References

MacDougall, M., Cameron, H.S. and Maxwell, S.R.J. (2019). Medical graduate views on statistical learning needs for clinical practice: a comprehensive survey. *BMC Medical Education*, 20(1) https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-019-1842-1

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