Clinical evidence and data interpretation:

‘Statistics’ in the AKT

A guide for a tutorial and/or peer group learning

If you have found yourself wondering why data interpretation and an understanding of statistics are being tested in the AKT, then we trust that this publication is of practical help to you.

We have not attempted to reproduce a traditional text book as that is much better done by experts, either in popular text books or on-line. Rather, our aim is to help you feel better placed to understand in principle what is being tested. We also hope that this document will help you generate wider discussions and further learning needs by using the questions posed throughout.

We have listed some practical examples of where statistics are relevant in day-to-day general practice in addition to the many examples of everyday statistics found widely on-line and in journals.

You might find the examples included here and others that you see during reading helpful to use as a basis for a tutorial with your trainer or to work through with colleagues? Please note that our list is not exhaustive and is only intended to be used as a platform to stimulate discussion.

Journal graphics

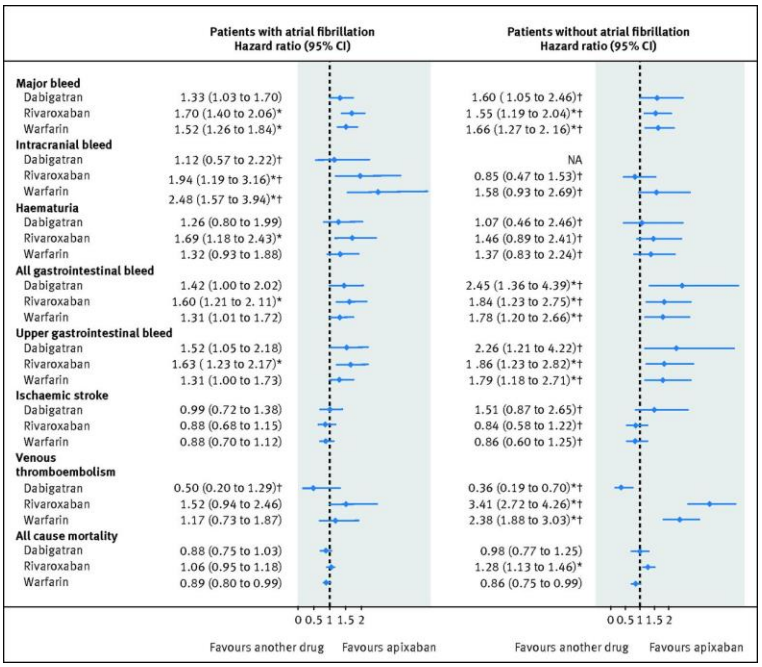
Have you seen information presented in different ways in journals? Below are some examples. Consider what you can interpret from the graphics.

4.01 - Alcohol-related mortality 2016

Directly standardised rate - per 100,000

Area	Recent Trend	Count	Value	95% Lower CI	95% Upper CI
England	–	23,839	46.0	45.5	46.6
North West region	–	3,732	54.7	52.9	56.5
Blackburn with Darwen	–	71	59.5	46.2	75.3
Blackpool	–	120	86.0	71.2	102.9
Bolton	–	145	56.8	47.9	67.0
Bury	–	95	53.5	43.3	65.5
Cheshire East	–	188	46.1	39.7	53.3
Cheshire West and Chester	–	176	50.5	43.3	58.6
Cumbria	–	253	46.2	40.6	52.3
Halton	–	64	54.5	41.8	69.8
Knowsley	–	102	73.5	59.7	89.4
Lancashire	–	588	49.5	45.6	53.7
Liverpool	–	269	67.7	59.7	76.4
Manchester	–	197	59.5	51.1	68.8
Oldham	–	112	56.3	46.3	67.8
Rochdale	–	118	61.9	51.1	74.2
Salford	–	120	58.6	48.4	70.2
Sefton	–	170	57.3	48.9	66.7
St. Helens	–	109	62.0	50.9	74.9
Stockport	–	138	47.4	39.8	56.0
Tameside	–	119	58.0	48.0	69.5
Trafford	–	97	44.5	36.0	54.3
Warrington	–	98	49.4	40.1	60.3
Wigan	–	174	56.2	48.1	65.3
Wirral	–	208	62.2	54.0	71.3

Source: Calculated by Public Health England: Risk Factors Intelligence (RFI) team from the Office for National Statistics (ONS) Annual Death Extract Public Health Mortality File and ONS Mid Year Population Estimates

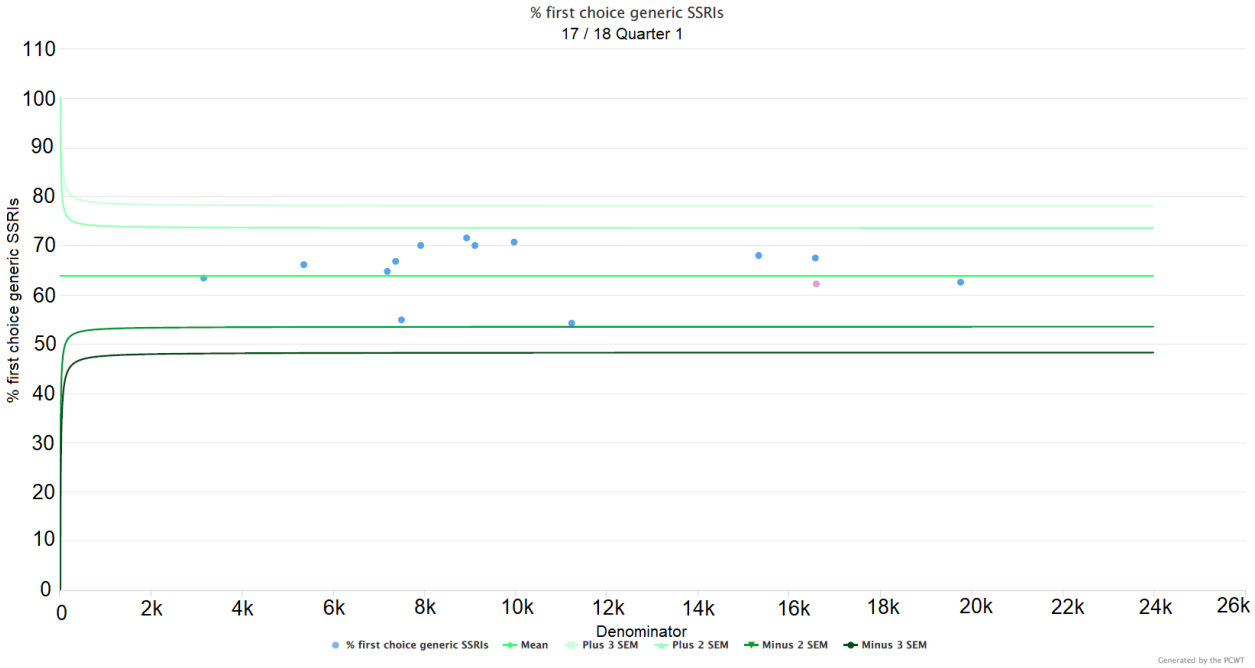


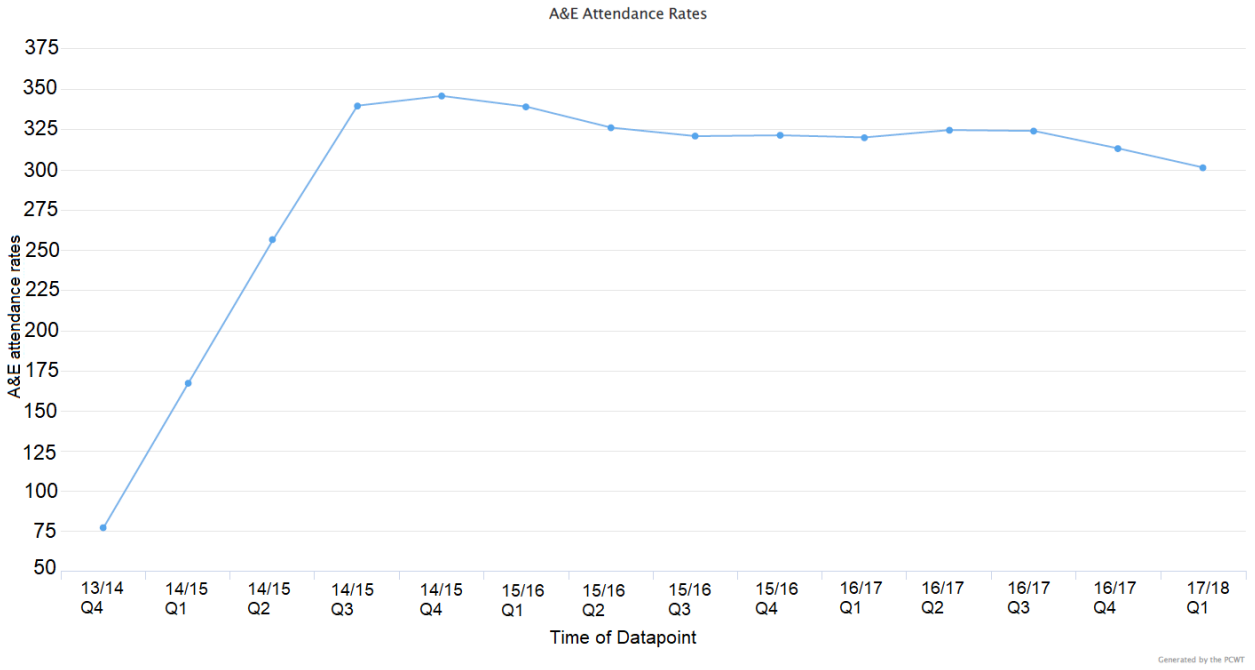
BMJ 2018;362:k2505

Pancreatic Cancer - "symptom-based" early diagnosis?

New onset diabetes	Diarrhoea	Constipation	Malaise	Nausea or vomiting	Abdominal pain	Loss of weight	Jaundice	
0.2 (0.2, 0.2)	0.2 (0.2, 0.2)	0.2 (0.2, 0.2)	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)	0.8 (0.7, 1.0)	21.6 (14,52)	PPV as a single symptom
0.3 (0.2, 0.4)	0.2 (0.1, 0.3)	0.3 (0.2, 0.4)	0.3 (0.2, 0.6)	0.3 (0.2, 0.5)	0.4 (0.3, 0.5)	2.0 (1.0, 4.3)	8.9 –	Back pain
	0.4 (0.3, 0.5)	0.4 (0.3, 0.6)	0.5 (0.3, 0.9)	0.7 (0.5, 1.0)	0.9 (0.7, 1.1)	1.6 (1.0, 2.9)	22.3 –	New onset diabetes
		0.2 (0.1, 0.3)	0.3 (0.1, 0.5)	0.2 (0.2, 0.3)	0.4 (0.3, 0.5)	2.7 –	>10 –	Diarrhoea
			0.3 (0.2, 0.5)	0.6 (0.4, 0.8)	0.5 (0.4, 0.7)	1.5 (0.8, 3.0)	>10 –	Constipation
				0.5 (0.3, 0.8)	0.6 (0.4, 0.8)	0.9 (0.4, 2.1)	>10 –	Malaise
					0.9 (0.7, 1.2)	2.2 (1.1, 4.6)	14.6 –	Nausea or vomiting
					1.0 (0.8, 1.2)	2.5 (1.5, 4.4)	15.0 –	Abdominal pain
							>10 –	Loss of weight
							31.6 –	Jaundice

- <1% = white
- 1-2% = yellow
- 2-5% = orange
- >5% = red


% first choice generic SSRIs
17 / 18 Quarter 1
% first choice generic SSRIs
110
100
90
80
70
60
50
40
30
20
10
0
0
2k
4k
6k
8k
10k
12k
14k
16k
18k
20k
22k
24k
26k
Denominator
% first choice generic SSRIs
Mean
Plus 3 SEM
Plus 2 SEM
Minus 2 SEM
Minus 3 SEM
Generated by the PCWT


A&E Attendance Rates
A&E attendance rates
375
350
325
300
275
250
225
200
175
150
125
100
75
50
13/14 Q4
14/15 Q1
14/15 Q2
14/15 Q3
14/15 Q4
15/16 Q1
15/16 Q2
15/16 Q3
15/16 Q4
16/17 Q1
16/17 Q2
16/17 Q3
16/17 Q4
17/18 Q1
Time of Datapoint
Generated by the PCWT

Areas to consider

How do you assess the quality of the information presented to you in a journal as well as the interpretation of the information itself?

What factors are important when looking at information that may make you change how you practise medicine?

Are you confident with your statistics terminology? For example, you would need to know what confidence intervals, standard errors of measurement, significance levels and positive predictive values (PPVs) are in order to understand the pictures above.

There are many statistical terms to understand, so here is a list from the new GP Curriculum that you may wish to consider.

Statistical Term	Personal notes on this term
Absolute risk	
Absolute risk reduction (ARR)	
Absolute risk increase (ARI)	
Association	
Bayesian probability	
Bias	
Blinding	
Case control	
Case fatality	
Cohort	
Confidence intervals	
Confounding	
Correlation	
Crossover	
Cross-sectional	
DALY (disability adjusted life year)	
Data types (categorical, ordinal, continuous)	

Delphi	
Discrimination	
Distributions (normal and non-parametric)	
Ethnography	
Event rate	
Focus group	
Generalisability	
Hazard Ratio	
Incidence	
Inclusion/exclusion criteria	
Likelihood ratios	
Mean	
Median	
Meta-analysis	
Mode	
Negative predictive value (NPV)	
Null hypothesis	
Number needed to harm (NNH)	
Number needed to treat (NNT)	
Odds & Odds Ratio (OR)	
Positive predictive value (PPV)	
Prevalence	
Probability	
p-values	
QALY (quality adjusted life year)	
Randomised controlled trial (RCT)	

Range	
Regression to the mean	
Relative risk (RR)	
Relative risk reduction (RRR)	
Reliability	
Risk ratio	
Risk reduction (RR)	
Sampling	
Sensitivity	
Specificity	
Standard deviation (SD)	
Standardised mortality rates and ratios	
Systematic review	
Trends	
Triangulation	
Type 1 and 2 errors	
Validity	

Guidelines

We often talk about national guidance; can you think of examples of organisations that produce guidance relevant to general practice?

Why might they differ on the same topic e.g. the SIGN/BTS and NICE 2017 asthma guidance?

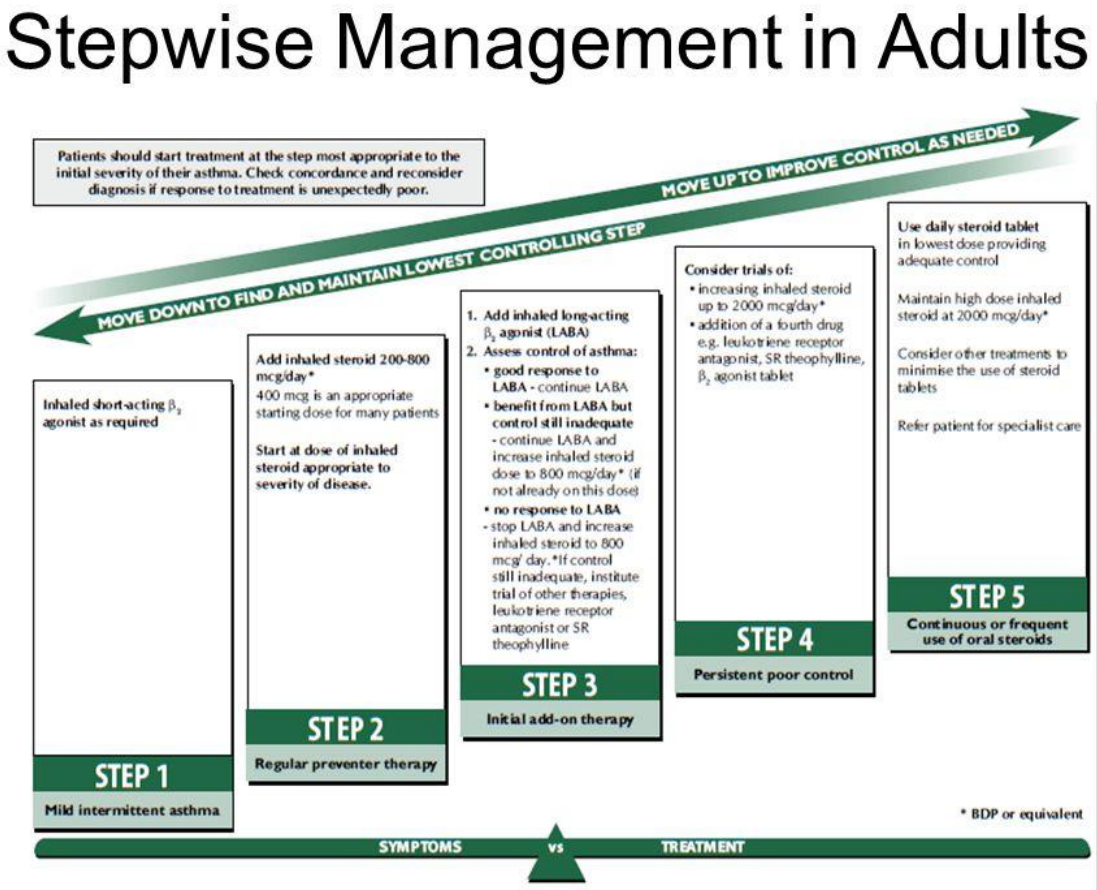
Do you know how they reach their recommendations including how reliable they are and how applicable they are to the whole of the UK?

Is all of the evidence used given equal weighting?

Can you think of reasons why the national guidelines may not be implemented?

An example of variations in national guidance is shown below and an interesting discussion of the differences in this example can be found on this BMJ link. In such situations, the AKT questions will evaluate all major guidance and will not ask candidates to choose between two contradictory pieces of advice.

BTS/SIGN Asthma Guidance



Scottish Intercollegiate Guidelines Network (SIGN). British Guideline on the management of asthma. Edinburgh: SIGN; 2016. (SIGN publication no. 153). [cited 17042019]. Available from URL: http://www.sign.ac.uk

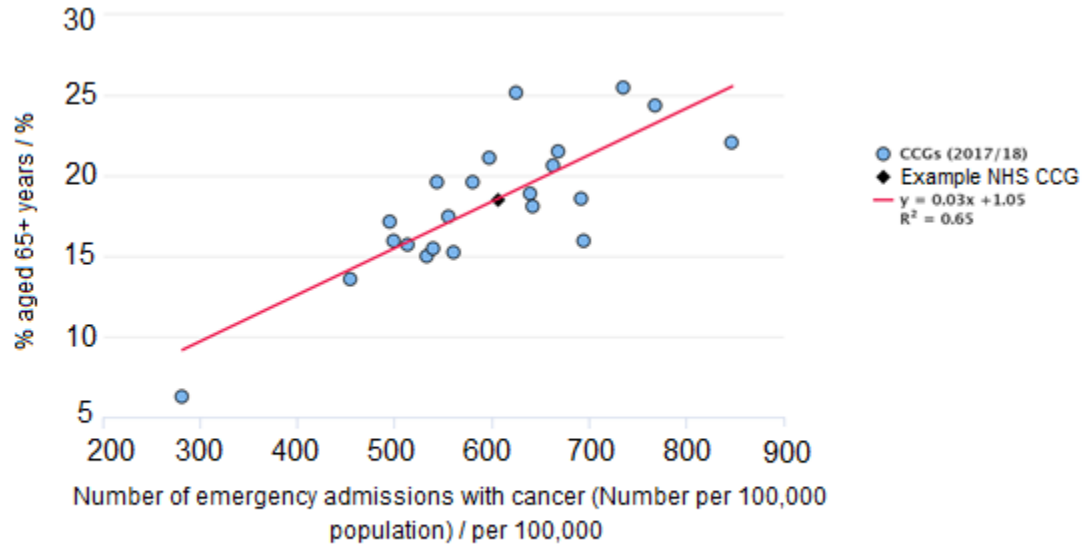
Exert from the NICE Guidelines on Asthma 2017

1.6 Pharmacological treatment pathway for adults (aged 17 and over)
This section is for people with newly diagnosed asthma or asthma that is uncontrolled on their current treatment. Where the recommendations represent a change from traditional clinical practice, people whose asthma is well controlled on their current treatment should not have their treatment changed purely to follow this guidance.
1.6.1 Offer a short-acting beta2 agonist (SABA) as reliever therapy to adults (aged 17 and over) with newly diagnosed asthma.
1.6.2 For adults (aged 17 and over) with asthma who have infrequent, short-lived wheeze and normal lung function, consider treatment with SABA reliever therapy alone.
1.6.3 Offer a low dose of an ICS as the first-line maintenance therapy to adults (aged 17 and over) with: symptoms at presentation that clearly indicate the need for maintenance therapy (for example, asthma-related symptoms 3 times a week or more, or causing waking at night) or asthma that is uncontrolled with a SABA alone.
1.6.4 If asthma is uncontrolled in adults (aged 17 and over) on a low dose of ICS as maintenance therapy, offer a leukotriene receptor antagonist (LTRA) in addition to the ICS and review the response to treatment in 4 to 8 weeks.
1.6.5 If asthma is uncontrolled in adults (aged 17 and over) on a low dose of ICS and an LTRA as maintenance therapy, offer a long-acting beta2 agonist (LABA) in combination with the ICS, and review LTRA treatment as follows: discuss with the person whether or not to continue LTRA treatment and take into account the degree of response to LTRA treatment.
1.6.6 If asthma is uncontrolled in adults (aged 17 and over) on a low dose of ICS and a LABA, with or without an LTRA, as maintenance therapy, offer to change the person's ICS and LABA maintenance therapy to a MART regimen with a low maintenance ICS dose.
1.6.7 If asthma is uncontrolled in adults (aged 17 and over) on a MART regimen with a low maintenance ICS dose, with or without an LTRA, consider increasing the ICS to a moderate maintenance dose (either continuing on a MART regimen or changing to a fixed-dose of an ICS and a LABA, with a SABA as a reliever therapy).
1.6.8 If asthma is uncontrolled in adults (aged 17 and over) on a moderate maintenance ICS dose with a LABA (either as MART or a fixed-dose regimen), with or without an LTRA, consider: increasing the ICS to a high maintenance dose (this should only be offered as part of a fixed-dose regimen, with a SABA used as a reliever therapy) or a trial of an additional drug (for example, a long-acting muscarinic receptor antagonist or theophylline) or seeking advice from a healthcare professional with expertise in asthma.

Local health data (CCG, Health Board, councils, UK wide)

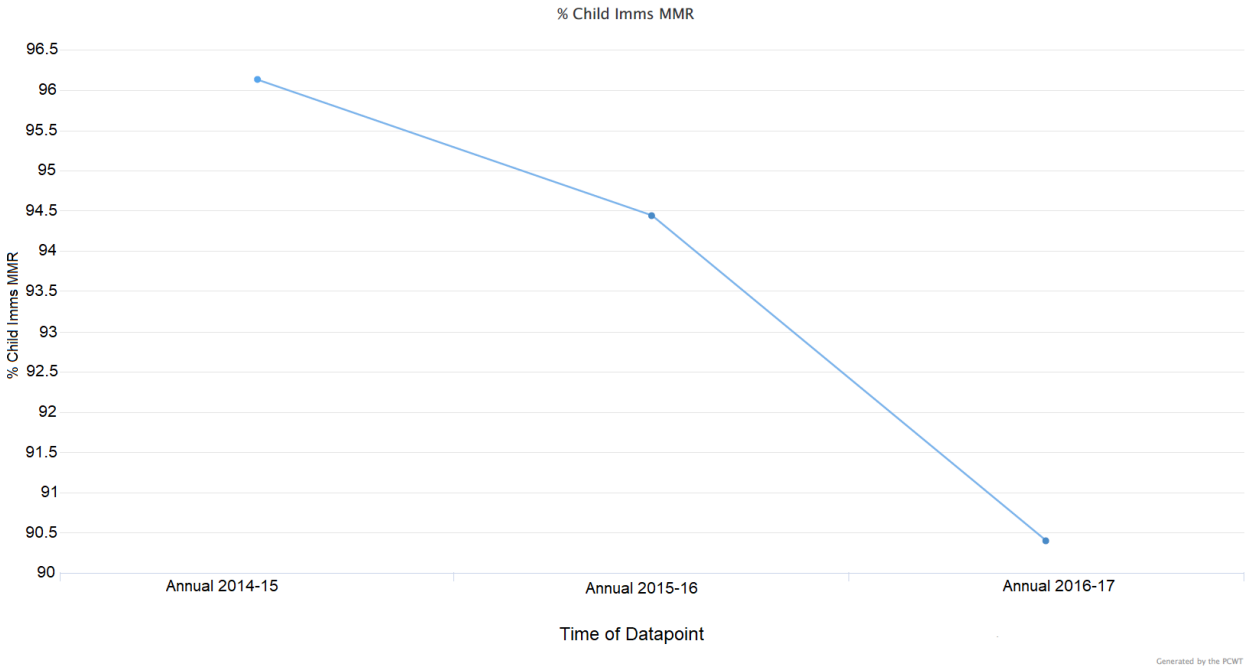
Think about why local health data matters and what they can be used for?

A wealth of data for England is available from www.fingertips.phe.org.uk. Have a look at your local area or choose an area and compare it to neighbouring areas/nationally. What information does it give you and how might this change what the practice targets? Why does this matter?



Adapted from https://fingertips.phe.org.uk

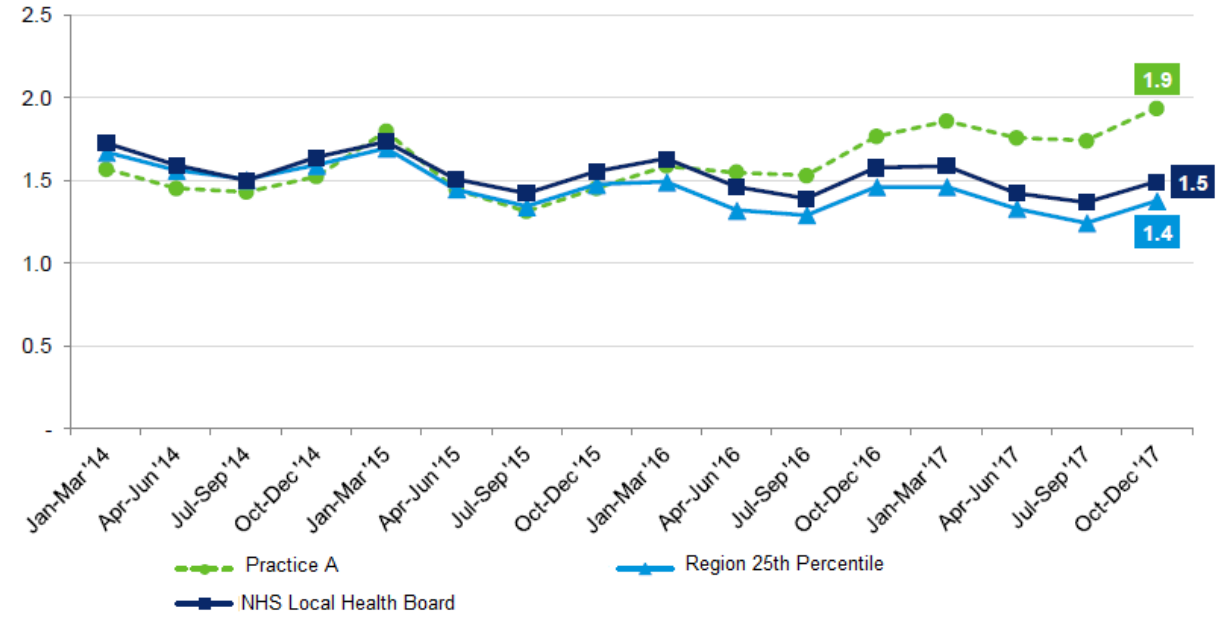
Looking at a specific factor such as vaccination uptake and identifying outlying practices, think about why this is important and what factors it can demonstrate? Do you know what your practice vaccination rates are like compared to other local practices/UK?



How can prescribing data be used at multiple levels; not only individual GPs but for practices, clusters of practices, CCGs/health boards and nationally? How can this data help with benchmarking?

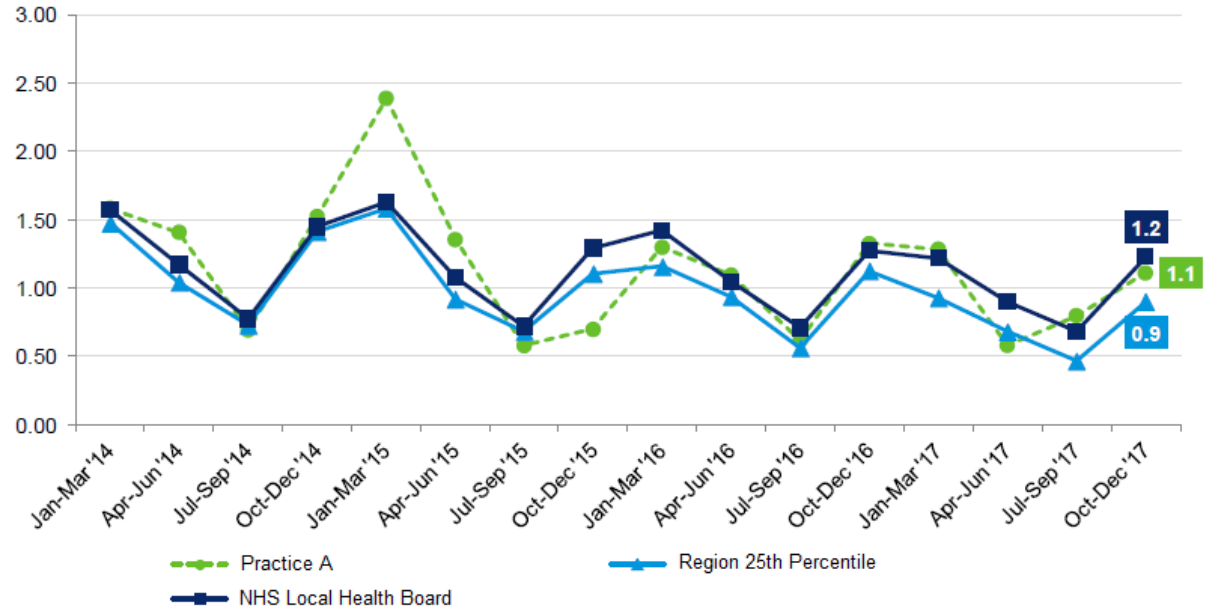
Indicator 1: Use of Antibiotics in All Ages

Number of Antibiotic Prescriptions Dispensed per 1,000 Patients per Day

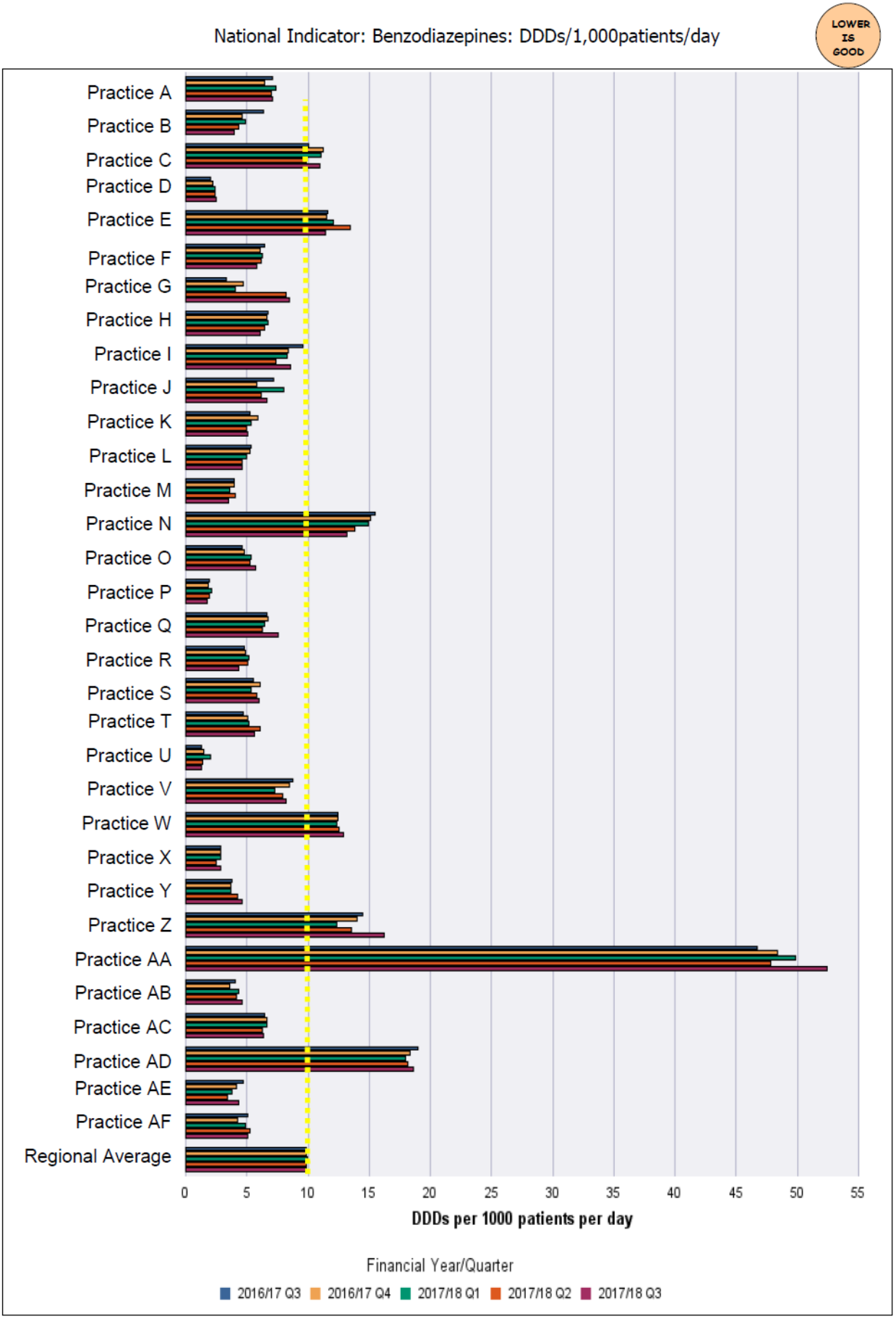


Indicator 2: Use of Antibiotics in Patients aged 0-4 Years

Number of Antibiotic Prescriptions Dispensed per 1,000 Patients aged 0-4 Years per Day



National Indicator: Benzodiazepines: DDDs/1,000patients/day



Public Health data

Why does this matter to GPs?

Some practical examples which demonstrate why an understanding of basic statistical concepts is important might include antenatal screening or the debate on a possible prostate screening programme. If you can interpret and explain the following related extracts of text to a patient, then you would be able to answer an AKT-style Single Best Answer question!

Antenatal screening

Dear Patient

Re: Your Down's syndrome result and your Edward's and Patau syndromes combined result from your nuchal scan and the blood specimen collected on 01/02/19.

The Down's result shows a risk of 1 in 1000 which is a Lower Risk result. The screening cut-off used is 1 in 150.

The Edward's and Patau combined result shows a risk of less than 1 in 50,000 which is a Lower Risk result. The screening cut-off used is 1 in 150.

It is important to understand that a lower risk does not exclude the possibility of Down's, Edward's or Patau syndrome pregnancy because screening does not detect all affected pregnancies.

Based on this result however, we would not normally offer any further testing for Down's or Edward's or Patau syndromes.

Please keep this letter in your maternity hand held notes and show it to your midwife at your next visit.

If you have any questions regarding this result please contact your Antenatal Screening Coordinator (or whoever is appropriate for your screening programme).

Kind regards,

Screening service

Controversies in PSA screening *Posted on 19th October 2017*

Most healthcare organisations do not recommend PSA screening for prostate cancer (USPSTF, Public Health England), mainly in response to conflicting evidence about the benefits and clear evidence of harms. PSA can lead to false positive or 'overdiagnosed' cancer (detecting prostate cells that histologically represent cancer, but will never grow to cause a patient harm).

Evidence regarding efficacy has been based on two large randomised controlled trials (RCTs). The European Randomised Study of Screening for Prostate Cancer (ERSPC)1 and Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial (PLCO)2. These trials are both considered to be of high quality, but the trials came to substantially different conclusions. The ERSPC showed a significant decrease in mortality in men screened with PSA compared to those that didn't receive a PSA, whereas the PLCO showed no difference in mortality between the two groups.

Various differences exist between these two studies that may contribute to this discrepancy: 1) differences in screening interval (annual in PLCO vs. every 2 to 4 years in ERSPC); 2) PSA threshold to biopsy (PLCO: 4.0 ug/L vs. 3.0 ug/L in ERSPC); 3) higher prostate cancer incidence in the USA than Europe before the trials started and 4) a varying degree of 'contamination' in each of the control groups: many patients in the control group – not randomised to PSA- actually received PSA testing.

In response to these differences, the Annals of Internal Medicine published an analysis of data from both the ERSPC and PLCO with statistical adjustments for the trial differences. The results of which showed a 16% (95%CI: 4 to 27%) reduction in mortality in those screened.

Can we trust these results?

The methods to statistically adjust appear to be completely novel and therefore not validated previously. This analysis includes pooled data from the two trials and adjusts for age and trial setting as well as four 'extended analyses'. These four 'extended analyses' were conducted to 'account for variable screening and diagnostic workup' between the two studies. All four 'extended analyses' and the 'traditional analysis' concluded that PSA screening significantly reduced mortality.

These methods have attracted a mixed response. Some, including Dr Kenneth Lin, a former medical officer at the Agency for Healthcare Research and Quality, argued that statistical models shouldn't be considered superior to real-life, patient data – '"No matter how sophisticated, they (statistical models) shouldn't trump data from real people who participated in the randomized trials". While others called for the controversies surrounding prostate cancer to 'finally (be) put to rest'.

The central issue that should inform policy is the question of the amount unnecessary risk subjects' are willing to accept in order to benefit or save one other person?

The authors of the Annals of Internal Medicine re-analysis of ERSPC and PLCO data report that five men will be overdiagnosed to save 1 man's life from Prostate Cancer. These five men will risk urinary incontinence, impotence and further harm for no benefit. The USPTF estimates that the number of men overdiagnosed to save 1-2 men's life is closer to 50.

Therefore, how much risk are we willing to subject patients to, with no benefit, to save one other person's life?

Jack O'Sullivan, Editorial Registrar BMJ EBM, Dr & DPhil Candidate at the University of Oxford

Areas to consider:

How is screening relevant to GPs?

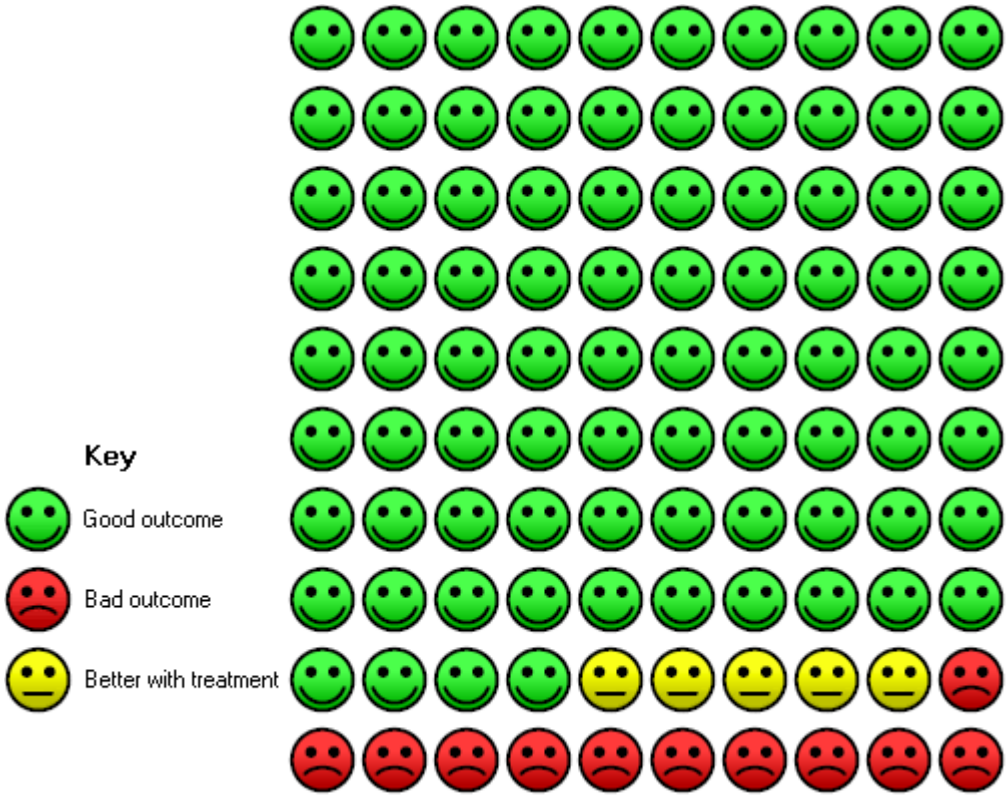
Can GPs influence uptake rates and how? How does your practice interpret the information about your population take-up of screening from letters that detail your screening rates?

How can you explain risks and benefits of screening programmes to patients e.g. the current mammogram screening leaflet?

What do you understand by risk, including relative risk, absolute risk, risk reduction, number needed to treat, number needed to harm? Could you explain this to a patient? Have you used decision aids to help patients visualise what risk means?

Try using the Cate's Plot below to explain the how pain is affected by giving antibiotics versus placebo for acute otitis media in children:

Cates plot of pain at 2-3 days in children given antibiotics versus placebo for acute otitis media



What factors might influence disease incidence?

When death rates are quoted in information, what does this actually mean? Is it all cause mortality or disease specific mortality? Does this matter?

Research, bias and influence of the media

Think of the many different and often conflicting media influences on your patients e.g. newspapers, social media, the internet and advertising (TV, drug advertising to the public, billboards etc).

What advice can you offer about which evidence to 'believe'?

How do you draw conclusions and establish what evidence is reliable?

What is the most reliable evidence?

Think of different common study design types used in research. Could you decide which are the most or least reliable? Factors such as sample size, funding, data control, peer review, conflicts of interest, consent and suppression of publication are also important when thinking about research projects. Can you think of other factors which may need to be considered?

Research is qualitative or quantitative. Think about the difference between these and can you think about times when each is most appropriate?

We often talk about using evidence to avoid bias but can you think of what bias actually is and the common types of bias? How can you avoid bias?

Drug companies frequently advertise their products in magazines and face to face to health care professionals. How would you interpret the significance of their drug? What factors would you need to consider when switching to prescribing this drug? In statistical terms what questions would you want to have answered about the drug to help in your decisions?

NHS Measures of quality

Look at the rating of your GP surgery, for example on NHS Choices, and consider data such as the 'Friends and Family' test of quality relevant to the practice.

What does this information tell you about your practice?

What factors make this information reliable or unreliable?

How might you go about changing areas as a result of this information? What would you prioritise?