# Antibiotics and Appendicitis AMS opportunities?

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# Setting the Scene

**Appendicitis**

- Number of Appendicectomies performed at WCH per annum - 400
  - Non-perforated – 60%
  - Perforated – 40%
  - Open – 70% perforated, 30% non-perforated
  - Laparoscopic – 30% perforated, 70% non-perforated
    - Surgeon dependent

- Average LOS
  - Non-perforated – 1.74 days
  - Perforated – 3.95 days
  - Total LOS – 418(non-perforated)+632(non-perforated)= 1050

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# Setting the Scene


**AMS Audit**

- Survey of 65 consecutive appendicectomies
- 1st Dec 2014 to 31st Jan 2015
- Total of 65 patients
  - 43 (66%) non-perforated, 9.23 years (2-15 years)
  - 22 (34%) perforated, gangrenous, 10.8 years (5-17 years)
  - Re-presentation – non-perforated 2 (0 admission), perforated 4 (1 readmission)

- **Surgical prophylaxis**
  - Appropriate (agent and dose as per surgical prophylaxis guidelines, <60 minutes knife to skin)? – less the 50%
    - Non-perforated – Inappropriate 59% - inappropriate timing (2.41 hours (1.21-4.39) prior to knife to skin), inappropriate dose, nil (3)
    - Perforated – Inappropriate 69% - inappropriate timing (3.49 hours (1.25-10.2) prior to knife to skin

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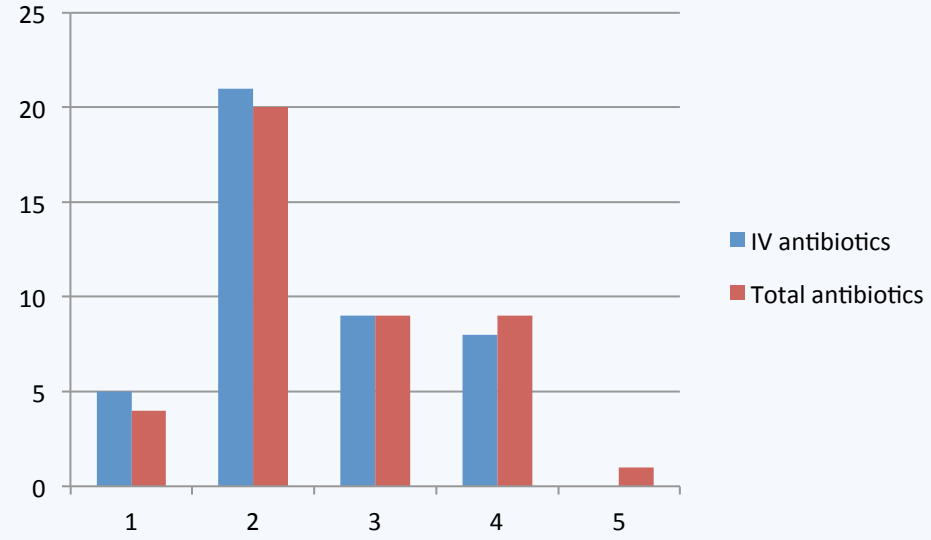
# Setting the scene

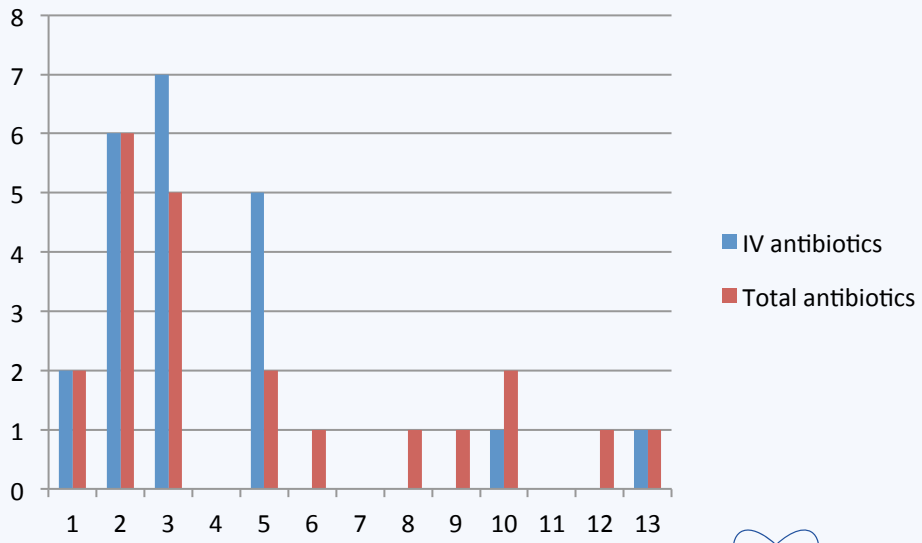
**AMS audit (2)**

- Duration of post-op therapy
- Significant practice variation between surgeons

Non-perforated appendicectomy




Perforated appendicectomy

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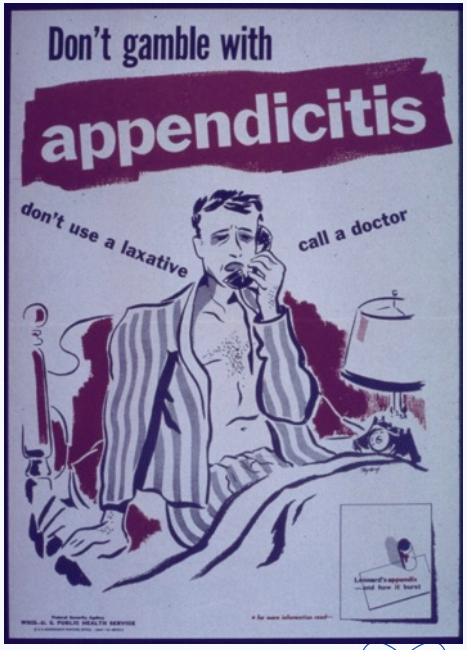
# Management Aims

- Diagnosis
  - Minimise removal of “normal” appendix i.e. false positives – 30%?, <10% if US included, <3-7% if CT included
  - Minimise re-presentation with appendicitis i.e. false negatives – 0.5% if US included
- Treatment
  - Effectively treat appendicitis to prevent complications
    - Recurrence
    - Prolonged symptoms – pain, fever
    - Wound infection
    - Abscess
    - *Clostridium difficile*, antimicrobial resistance
- Manage resources
  - Minimise LOS, antimicrobial use, OR time

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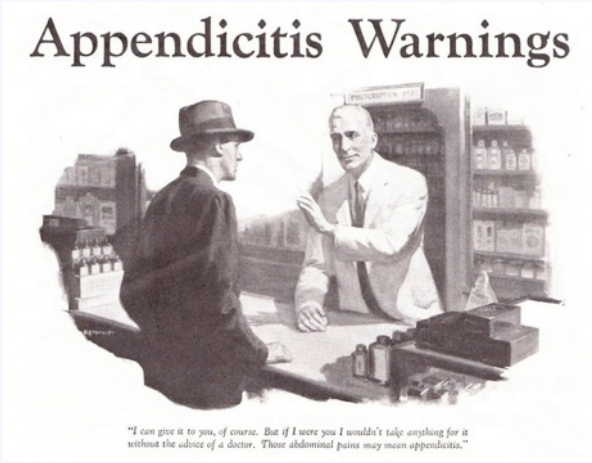
# Achieving Aims

- Review evidence base
- Standardise practice according to the evidence base
- Develop a written protocol
- Publicise and obtain agreement amongst surgeons
- Audit compliance with protocol
- i.e. standard quality improvement cycle

- Appendicitis protocols
  - Non-perforated
  - Perforated
  - Established Abscess

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# Evidence base – diagnosis

- Clinical assessment scores – signs, symptoms & WCC
  - Alvarado, PAS (paediatric appendicitis score)
  - Insufficient unless combined with radiology

Pogorelic, Ped Emerg Care 2015
Bachur, J of Ped 2015

- Radiology
  - Appropriateness criteria published by American College of Radiology
    - CT plus contrast 8, CT without contrast 7
    - RLQ ultrasound with graded compression 6, plain AXR 5, MRI 4
    - Barium enema 3, technetium-99m white cell scan 3
  - RLQ ultrasound is preferred for children and pregnant women to reduce radiation exposure. Increasing use of US cf CT in children not associated with increase in normal appendicectomies or missed cases**,***
  - US sensitivity 78%, specificity 83%, CT sensitivity 91%, specificity 90%(meta-analysis ****), bedside US in ED sensitivity 67%, specificity 98%*
  - US is extremely operator-dependent. Also limited usefulness in obese patients, those with significant pain, retrocaecal appendix
  - CT has particular role where appendiceal perforation is suspected and to guide surgical or percutaneous drainage, MRI in pregnant women

*Elikashvili et al Academic Emergency Medicine 2014 ** Bachur et al JAMA Pediatr. 2015
*** Le et al Am J Roentgenol 2013 **** van Randen Radiology 2008

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# Evidence base - definitions

- Uncomplicated
  - Simple, non-perforated
- Complicated
  - Purulent, perforated, gangrenous, necrotic, ruptured, +/- peritonitis
- Based on clinical impression rather than objective criteria. Significant lack of congruity between surgeons in determining perforation
- Contributes to large variability in reported perforation rates and post-operative complication rates in published literature. Comparison between/combining studies difficult
- Holcomb* proposes classifying as perforated and non-perforated
  - Grossly identifiable hole in the appendix or a fecalith in the abdomen
  - Black and white definition
  - Separates those with a substantial risk of post-operative abscess from those with a minimal risk
  - Gangrenous appendicitis belongs in the non-perforated group

*Holcomb Eur J Pediatr Surg 2012

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# Evidence base – Operation? Non-perforated appendicitis

NB perforated appendicitis-
Early laparoscopic appendicectomy
Blakely 2011 Arch Surg

- Operative -
  - Open – paediatric complication rate: 2.7% non-perforated, 18% perforated
  - Laparoscopic – paediatric complication rate: 2.6% non-perforated, 16% perforated
- Non-operative
  - Acute uncomplicated appendicitis no longer considered as an invariably irreversible disease requiring aggressive surgical treatment in all circumstances
  - Antibiotic therapy the first step in a treatment algorithm reserving appendicectomy for those not responding
  - Adults
    - *530 Adults uncomplicated acute appendicitis (CT) randomly assigned to early appendicectomy (open) vs antibiotic treatment (ertapenem 3 days + levofloxacin/metronidazole 7 days) with 1 year follow up
    - In antibiotic group, 27% appendicectomy within 1 year (10% with complicated appendicitis)
    - Complication rate (SSI, incisional hernia, abdominal/incisional pain) – 21% in surgical group, 7% in delayed surgical group, 3% in overall medical management group. Sick leave – 19 days (surgical) vs 7 days (medical)
    - 1.5% in surgical group found to have tumours
    - No major complications associated with delayed appendicectomy
  - Children
    - No RCTs
    - **Multi-centre, prospective cohort study uncomplicated acute appendicitis (US): 44 eligible, 25 participants. Patients received 2-3 days of IV augmentin + gentamicin, then oral augmentin for total of 7 days. Delayed appendicectomy in 2 patients, 23 patients asymptomatic at 8 week follow up
    - *** Single-centre, selected patients (US, local peritonitis) treated with IV antibiotics 3-5 days plus additional 5 days oral antibiotics – 40/45 avoided surgery (6-14 month follow up), 3/45 immediate appendicectomy 2/45 delayed appendicectomy

* Salminen et al JAMA 2015 **Gorter et al Surgery 2015 *** Steiner et al J Ped Surg 2015

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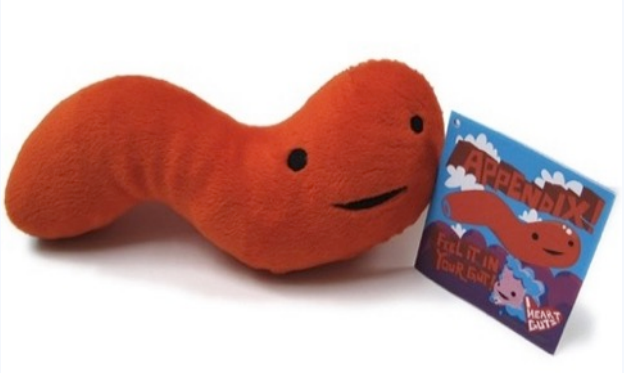
# Evidence base - antibiotics




- Peri-operative – systematic reviews *, **
  - Non-peforated – Yes
  - Perforated – Yes
- Post-operative
  - Non-perforated – No **,*
  - Perforated – Yes, use of no post-op antibiotics not been studied
- IV to oral switch – Necessary?*, *****
- Agent –
  - tazocin, amp/gent/metronidazole, ceftriaxone/metronidazole ***
  - equal efficacy, reduced costs and toxicity
- Duration
  - Non-peforated – peri-op prophylaxis only
  - Perforated
    - Traditionally – 7-10 days IV
    - 5 days IV – systematic review –****

***** Nadler Surg Inf 2008

Daskalakis, Scand J Surg 2013* Mui, ANZ J Surg 2005*** Anderson, Cochrane Database Syst Rev 2005** ****Lee, J Ped Surg 2010

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# Duration of therapy Perforated appendicitis

- Early vs interval appendicectomy

- *270 children, perforated, prospective observational
  - Control group - Post-op IV antibiotics 5 days, if elevated WCC continue IV antibiotics for further 2 days
  - Experimental group – discharge prior to 5 days when afebrile and normal diet, if elevated WCC discharge on oral antibiotics to complete 7 days total course
  - No statistically significant difference in rate of post-op abscess between groups, with or without discharge oral antibiotics
  - Significant decrease in post-op antibiotic use
- **518 Adults , multi-centre, RCT,
  - Complicated intra-abdominal infection
  - Fixed duration, 4+/-1 days of IV antibiotics post-op, 257 (211 adhered)
  - 2 +/- 1 days after resolution of physiological abnormalities, 260 (189 adhered)
  - Outcomes – intra-ab infection, SSI, death – no significant difference
  - Antibiotic duration – 4 vs 8 days

- ***267 adults, perforated, prospective cohort,
  - Location A – 126 (3 days IV) – laparoscopic 57.1% - LOS 4 days
  - Location B – 141 (5 days IV) – laparoscopic 10.6% - LOS 6 days
  - No significant difference in rate of SSI or post-op abscess

* Desai J Ped Surg 2015 **Sawyer NEJM 2015 *** van Rossem BJS 2014

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# Standardising practice

- **"There is now compelling evidence that the use of protocols for patient care management improves both the process of care and patient outcomes"** IDSA Complicated Intra-abdominal Infection Guidelines 2010

- Local pathways for the evaluation, antimicrobial treatment and surgical management of **non-perforated** appendicitis

- **Perforated appendicitis**
  - * evidence based care guideline for treatment of perforated appendicitis
  - Appendicectomy within 24 hours
  - Post-op antibiotics until afebrile and normal diet
  - Check WCC – if normal d/c no further antibiotic, if ↑ d/c with oral antibiotics to complete a 7 day course
  - No increase in abscess rate
- **Performance measures**
  - Time from diagnosis of appendicitis to administration of antimicrobial therapy
  - Negative appendicectomy rate
  - Duration of prophylactic antimicrobial therapy for patients with non-perforated appendicitis
  - Duration of antimicrobial therapy and incidence of SSI for perforated appendicitis

* Slusher J Ped Surg 2014

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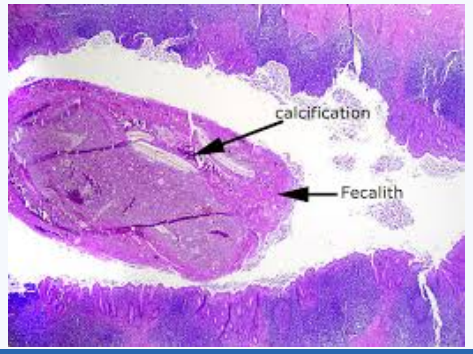
# WCH Activities

- Audit of diagnostic accuracy of ultrasound
  - 6 year study
  - 3900 examinations
  - Identification of appendix -91.7%, in past 6 months – 96%
  - Overall diagnostic performance – sensitivity 97%, specificity 94.8%
  - Only 0.7% had CT – obese, unable to tolerate transducer pressure

- Audit of pathologic findings
  - Overall negative appendicectomy – 4.6%
  - If appendicitis diagnosed on ultrasound – 2%
  - September 2015
  - 31 cases – 26 confirmed appendicitis, 2 faecoliths, 1 enterobius, 1 lymphoid hyperplasia, 1 fibrous obliteration of tip





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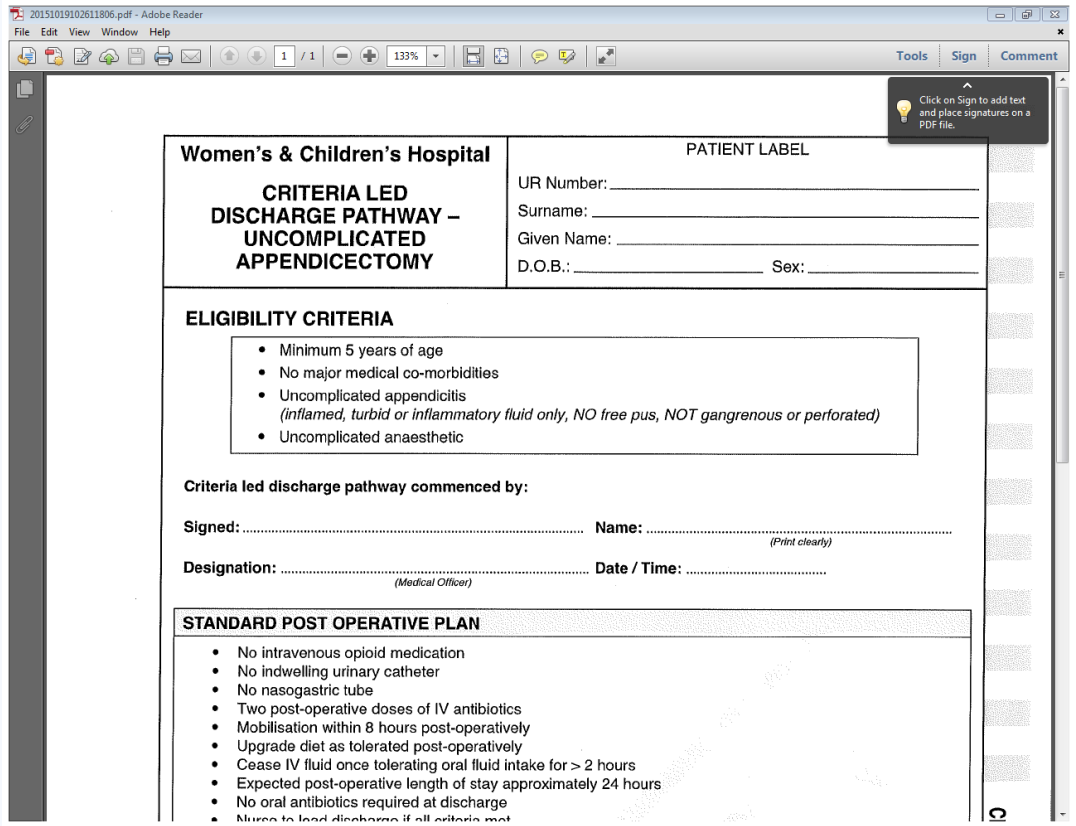
# Criteria led discharge

- Prepared by surgical fellow in response to excessive LOS and AMS audit data
  - 2 post-op doses of IV antibiotics
  - Expected post-op LOS 24 hours
  - No oral antibiotics at D/C
- Run as standard QI program – PDSA
- 180 days followed by assessment
- AMS audit planned for Oct-Nov data
- Clinical review planned for Jan-Feb 2016



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**Women's & Children's Hospital**

**CRITERIA LED DISCHARGE PATHWAY – UNCOMPLICATED APPENDICECTOMY**

PATIENT LABEL

UR Number: _____

Surname: _____

Given Name: _____

D.O.B.: _____ Sex: _____

**ELIGIBILITY CRITERIA**

- Minimum 5 years of age
- No major medical co-morbidities
- Uncomplicated appendicitis
  *(inflamed, turbid or inflammatory fluid only, NO free pus, NOT gangrenous or perforated)*
- Uncomplicated anaesthetic

**Criteria led discharge pathway commenced by:**

**Signed:** ..... **Name:** .....
*(Print clearly)*

**Designation:** ..... **Date / Time:** .....
*(Medical Officer)*

**STANDARD POST OPERATIVE PLAN**

- No intravenous opioid medication
- No indwelling urinary catheter
- No nasogastric tube
- Two post-operative doses of IV antibiotics
- Mobilisation within 8 hours post-operatively
- Upgrade diet as tolerated post-operatively
- Cease IV fluid once tolerating oral fluid intake for > 2 hours
- Expected post-operative length of stay approximately 24 hours
- No oral antibiotics required at discharge
- Nurse to lead discharge if all criteria met

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# Appendiceal Abscess

- Optimal management?
  - Controversial, sparse evidence
  - Conservative approach
    - Safe in most patients, low risk of complications including in children
    - Success rate of 80-90%
    - Regular clinical +/- radiological evaluation
    - Broad spectrum antibiotics until normalisation of temperature and inflammatory markers
  - Percutaneous drainage
    - Lowers the risk of treatment failure and subsequent surgery
    - Risk of complications from drain placement 2-15%
  - Immediate surgery
    - High complication rate
    - Reserve for patients with treatment failure after conservative treatment or drainage

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