Evidence Behind Interventions to Control MRSA

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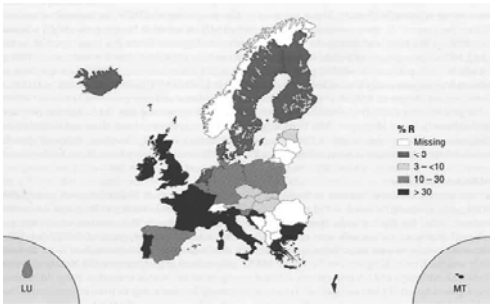

Mean proportion of *Staphylococcus aureus* methicillin resistance (MRSA) in blood isolates from the period 1999-2001. (EARSS data)

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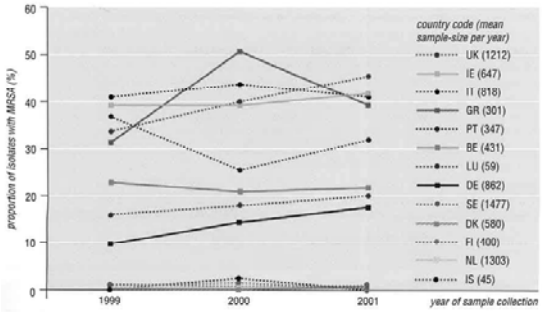

Staphylococcus aureus methicillin resistance (MRSA) in blood isolates from 1999 to 2001. Only countries that were included in EARSS for all three years of surveillance are presented.

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Proportion of *S. aureus* bacteraemia due to MRSA

Year	%
1997	15
1998	24
1999	34
2000	40
2001	45
2002	46
2003	37

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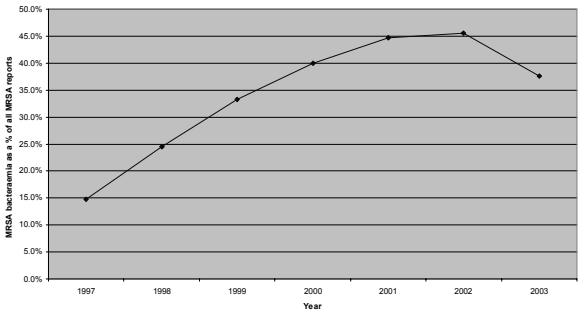
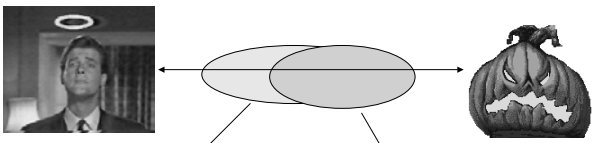
MRSA bacteraemia as a proportion of all *S.aureus* reports to SCIEH 1997 to 2003



Pathogenicity spectrum

***Staphylococcus aureus* – Saint or Sinner?**



E-MRSA-15 **E-MRSA-16**

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Morbidity attributable to MRSA in patients

Bacteraemia	
Alone	1
With septic shock	3 (2 deaths)
With pneumonia and septic shock	3 (1 death)
Deep surgical wound infection	
Empyema	1
Pelvic abscess	1
Perianal abscess	1
Infected joint prosthesis	2
Superficial surgical wound infection	8
Cellulitis	6
Abscess	2
Urinary tract infection	12
Total no of episodes of infection	40
Total no of deaths attributable to MRSA	3

'This evidence of nosocomial infection with associated mortality….is sufficient to justify rigorous control measures.'

(Law MR *et al*, Epidem Inf, 1988)

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MRSA – Pathogenicity issues

1 Carriage is more likely to lead to infection

(Muder *et al*, Ann Intern Med 1991; Pujol *et al*, Am J Med 1996)

2 MRSA bacteraemia has a worse outcome than MSSA; methicillin resistance is an independent risk factor for death

(Romero – Vivas *et al*, Clin Infect Dis 1995; Cosgrove S *et al*, Clin Infect Dis 2003)

3 Vancomycin is not as good at treating MRSA as flucloxacillin is for MSSA

(Gonzalez *et al*, Clin Infect Dis 1999)

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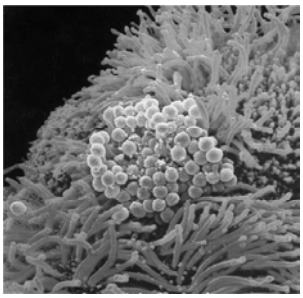

Epidemicity of *S.aureus*

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Epidemicity of MRSA

Are MRSA more transmissible than MSSA?

Probably not!

(A. Voss, HIS Conference Edinburgh, 2002)

But the properties of the epidemic strains currently circulating in the UK (EMRSA-15 and 16) mean that the usual epidemiology is specifically skewed towards increased transmissibility. These strains replace resident staphylococci in the nose and at other carriage sites.

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Hospital factors

1. MRSA does not replace hospital-acquired infections due to MSSA, it adds to them

   (Herwaldt LA, Am J Med 1999)

2. The prevalence of MRSA in a hospital correlates strongly with the number of patients with MRSA bacteraemia.

   (Harbarth *et al*, J Hosp Infect 2000)

3. MRSA incidence reflects the general effectiveness of infection control practice.

   (Herwaldt LA, Am J Med 1999)

4. If you manage to control MRSA, you end up controlling other hospital-acquired infections as well.

   (Wagenvoort JHT, Eurosuveillance 2000)

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Community prevalence of MRSA

1. Community – acquired MRSA infections: a new source for nosocomial outbreaks (Saravolatz *et al*, Ann Intern Med 1982)
2. Four paediatric deaths from community – acquired MRSA – Minnesota and North Dakota, 1997-1999 (MMWR 1999)
3. New trends in *S.aureus* infections:glycopeptide-resistance in hospital and methicillin-resistance in the community (Hiramatsu *et al*, Curr Opin Infect Dis 2002)
4. Community-acquired MRSA carrying Panton-Valentine leukocidin genes (Vandenesch *et al*, Emerg Infect Dis 2003)

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'The increasing trend of MRSA infection in the community indicates that MRSA has started replacing MSSA to establish itself as our ultimate natural flora – just as penicillin – producing *S.aureus* replaced its penicillin-susceptible predecessor since the 1940's'

(Hiramatsu *et al*, Curr Opin Infect Dis 2002)

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'…those who forget their history are condemned to repeat it….'

Ralf Waldo Emerson

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MMWR

Weekly
July 5, 2002 / 51(26);565-567

***Staphylococcus aureus* Resistant to Vancomycin --- United States, 2002**

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Money talks….

MRSA infections cost three times more to manage than infections with MSSA;
(Abramson & Sexton, Infect Control Hosp Epidemiol 1999)

Basic control programmes cost approximately half that of treating one single MRSA bacteraemia;
(Rao *et al*, Infect Control Hosp Epidemiol 1988)

Screening patients from St.Elsewheres could save thousands of dollars - $20,000-460,000;
(Jernigan *et al*, Am J Epidemiol 1995)

Doubling the cleaning on one ward eradicated epidemic MRSA and saved £28,000.
(Rampling *et al*, J Hosp Infect 2001)

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Revised Guidelines for the control of methicillin-resistant *Staphylococcus aureus* infection in hospitals.

J Hosp Infect 1990, 1998, 200?

Why have control measures not worked?

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Guidelines are not stringent enough
MRSA is being brought back into hospitals
Colonisation is more prolonged than previously thought
Ageing population and blocked beds
Mupirocin resistance
Inadequate isolation facilities
More specialist procedures and more patients
Crowded wards; 'hot' bedding; patients moved all over the hospital
Understaffing
Erosion of microbiology teaching for medical students
Hospital mergers; service and laboratory centralisation
Senior staff have underestimated the importance of basic cleaning
Lack of leadership from Infection Control Seniors
Worsening infrastructure in the NHS

(French G HIS, Edinburgh 2002)

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Do topical clearance regimens work?

How do we know when half the time they are not being done properly!

Common omissions:
- Hair wash inclusion
- Finger-nails
- Clothes and footwear
- Soft furnishings; toys
- Inadequate cleaning
- Prostheses/dressings
- 'Ping-pong' phenomenon
- Relatives

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What happens if you don't try to control MRSA in a hospital?

Year	Lab isolates of MRSA %	Prevalence MRSA patients %	No of MRSA bacteraemias	No of MSSA bacteraemias
1989	3	0.07	1	94
1990	6	0.23	8	78
1991	11	0.38	13	83
1992	17	0.84	34	96
1993	19	0.93	26	95
1994	20	1.42	31	102
1995	24	1.35	23	97
1996	21	1.02	12	98
1997	19	0.59	10	98

(Harbarth *et al*, J Hosp Infect 2000)

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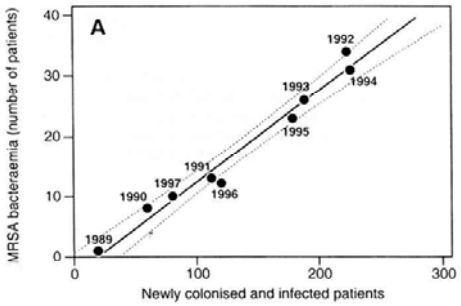

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What are the basic control measures we have against MRSA?

Isolation and cohorting
Screening
Topical clearance
Education
Hand washing
Cleaning
Antibiotic management

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What is the evidence for isolation as an effective control measure for MRSA?

A systematic review of isolation policies in the hospital management of MRSA found that only four studies (of 46 meeting the review criteria) provided some evidence that isolation, along with other control measures, was effective in controlling MRSA.

(Cooper *et al*, Health Technol Assess 2003)

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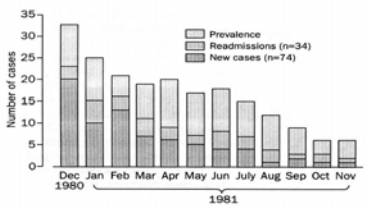

Effect of control measures. After more than 2 years of increasing rates of MRSA nosocomial infections, the prevalence was progressively reduced hospital-wide following implementation of a programme of screening and contact isolation of all colonised patients.

(Thompson *et al*, Ann Intern Med 1982)

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Evidence that basic control measures have an impact on MRSA

Screening and contact isolation halted an outbreak in a neonatal intensive care unit. (Jernigan *et al*, Am J Epidemiol 1996; Karchmer *et al*, J Hosp Infect 2002)

Screening, isolation and education was associated with a significant reduction in the rate of MRSA infection in a paediatric ICU. (Cosseron-Zerbib *et al*, J Hosp Infect 1998)

Screening, cohorting and topical clearance helped to establish areas where MRSA is never acquired. (Barakate *et al*, J Hosp Infect 2000)

Prospective screening, handwashing and gloving practices can control MRSA in hospitals. (Hartstein *et al*, Infect Control Hosp Epidemiol 1997)

Incidence of MRSA ventilator-associated pneumonia decreased significantly after a bi-weekly topical clearance regimen and cohorting. (Rumbak & Cancio, Crit Care Med 1996)

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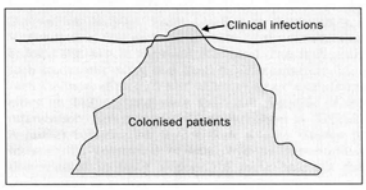

Reservoir for spread. The reservoir for spread of antibiotic-resistant, nosocomial pathogens consists of a relatively small number of patients with clinically obvious infection (the tip of the iceberg) and a much larger subset of colonised patients who remain unrecognised and unisolated in the absence of screening.

(Farr *et al*, Lancet Infectious Diseases 2001)

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More on screening….

Successful control programmes for MRSA are based on early identification (screening) and prompt implementation of contact precautions. (Rubinovitch & Pittet, J Hosp Infect 2001)

Selective screening for nasal carriage during admission to a medical ICU reduced the rate of MRSA colonisation/infection from 5.6% to 1.4% ($P<0.001$). (Girou *et al*, Clin Infect Dis 1998)

Best hospital practices for controlling MRSA include the need to increase screening of patients.
(Rhode Island Guidelines: Arnold *et al*, Infect Control Hosp Epidemiol 2002)

SHEA guideline for preventing nosocomial transmission of multi-drug resistant strains of *S.aureus* and enterococcus. (Muto *et al*, Infect Control Hosp Epidemiol 2003)

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Screening?

'You can't control what you don't know about'

Voss A, HIS Conference, Edinburgh, 2002

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Mopping up MRSA

Evidence that basic cleaning at ward level can have a significant impact on MRSA acquisition.

(Dancer SJ, J Hosp Infect 1999; Rampling *et al*, J Hosp Infect 2001)

Why should cleaning be important?

'The effects of exemplary hand-hygiene are eroded if the environment is heavily contaminated with MRSA'.

(Farr *et al*, Lancet Infect Dis 2001)

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Is cleaning important?

Since cleaning has never been regarded as an evidence-based science, we really do not know how important it is to maintain a clean environment in the hospital

Furthermore, there is no way of 'measuring' cleanliness other than visual assessment

(Griffith *et al*, J Hosp Infect 2000)

Perhaps we should introduce microbiological standards for surface hygiene using HACCP principles. Hand-touch sites are more important than floors!

(Dancer SJ, J Hosp Infect 2004)

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Handwashing and MRSA

Improving handwashing compliance over a three year period coincided with a significant reduction in MRSA transmission rate from 2.16 to 0.93 episodes per 10,000 patient-days ($p<0.001$).

(Pittet *et al*, Lancet 2002)

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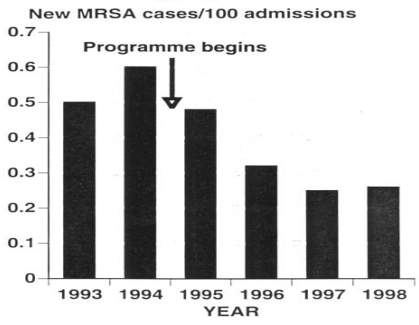
Figure 1: New MRSA cases before and after the hand-washing programme started



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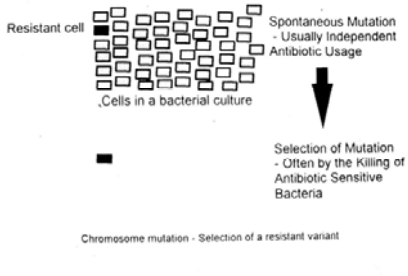
Role of antibiotics in the control of MRSA



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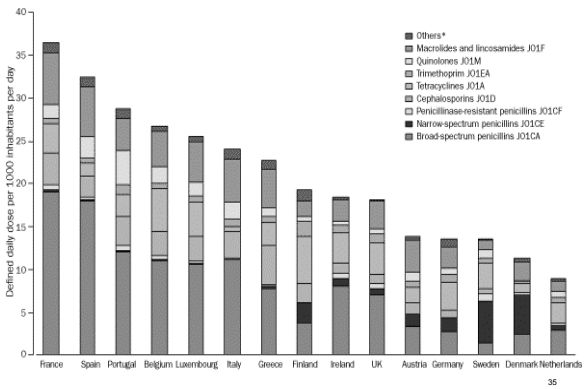

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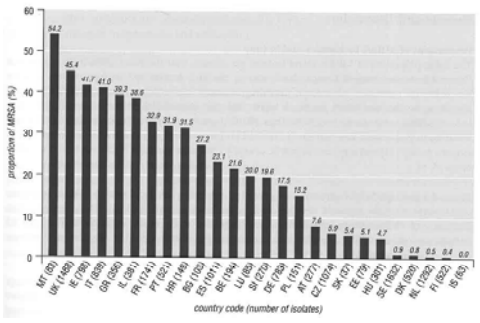

Staphylococcus aureus methicillin resistance (MRSA) in blood isolates per country in 2001. (EARSS data)

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Could changing or restricting antibiotics have an impact on MRSA in a hospital?

(Frank *et al*, Clin Perform Qual Health Care 1997)
(Monnet D, Infect Control Hosp Epidemiol 1998)
(Dancer SJ, J Antimicrob Chemother 2001)
(Weber *et al*, Emerg Infect Dis 2003)
(Landman *et al*, Clin Infect Dis 1999)

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Other antibiotic-related studies:

Tetracycline not only selects for resistance in S.aureus, it also appears to encourage staphylococcal transmissibility
(Berntsen & McDermott, New Eng J Med 1960)

Ciprofloxacin selects for resistant subsets of MRSA
(Venezia *et al*, JAC 2001)

Prophylactic cephazolin is a risk factor for deep surgical wound infections with borderline oxacillin-susceptible S.aureus

(Kernodle *et al*, J Clin Micro 1998)

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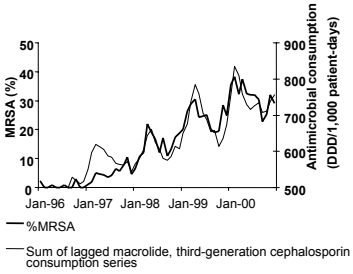
Evolution of the monthly %MRSA and monthly sum of lagged antimicrobial use of macrolides, third-generation cephalosporins and fluoroquinolones, Aberdeen Royal Infirmary, 1996 - 2000



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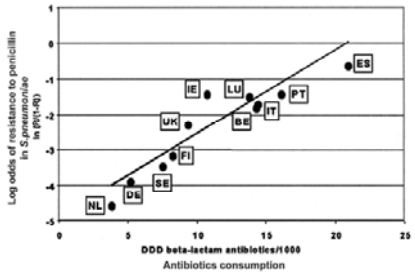
The Relationship between Antimicrobial Use and Antimicrobial Resistance in Europe



(Bronzwaer *et al*, Emerging Infectious Diseases 2002)

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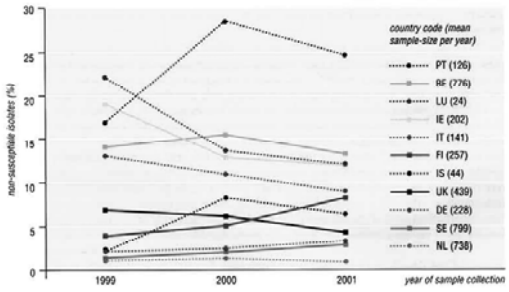

Streptococcus pneumoniae penicillin non-susceptibility invasive isolates from 1999 to 2001. (EARSS data)

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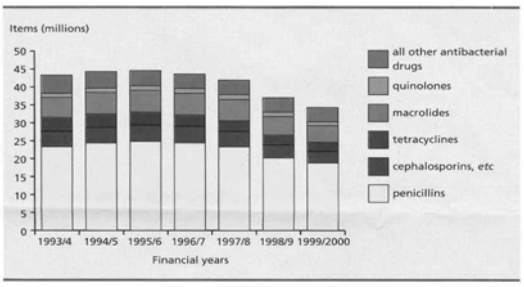

Trends in the prescribing of antibacterial drugs in general practice in England

(J Ferguson, Prescribing 2001)

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Conclusion

Simple control measures for MRSA work. There is nothing wrong with the Guidelines. What we need are motivation and leadership from Infection Control staff and support from managers and policy makers at all levels.

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Does trying to control MRSA cause more problems than it solves?

Yes! Barrett *et al*, J Hosp Infect 1998, 2000

No! Dancer S, J Hosp Infect 1999, 2001

When is the MRSA pendulum going to stop swinging?

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'Those accustomed to the high and growing rate of MRSA infection……should consider their current national rate with that of countries such as Denmark and Holland and ask themselves if they are comfortable with our present course, because the difference in outcome appears to be one of choice, not chance.'

(Farr & Jarvis, Infect Control Hosp Epidemiol 2002)

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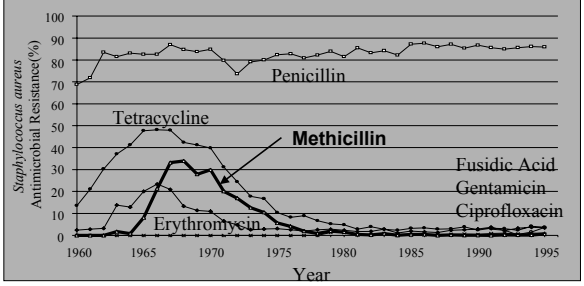
Antimicrobial Resistance Surveillance in *Staphylococcus aureus* Blood Isolates, Denmark, 1960-1995



Source: DANMAP Report, 1997.

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What can we do?

Review domestic services

Hand hygiene for everyone

Increase screening

Stop inappropriate antibiotic prescribing

Take on the bed managers!

Speed up laboratory identification

Just because something is difficult doesn't mean that it's not worth trying…….

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'There has been enough debate; lets take the half-century worth of data that we have and try to change the things we should while we can'

(Farr & Jarvis, Infect Control Hosp Epidemiol 2002)

'Stop talking and start doing something to prevent the spread'

(Wendell Holmes 1843)

'Imagination is more important than knowledge…'

(Albert Einstein)

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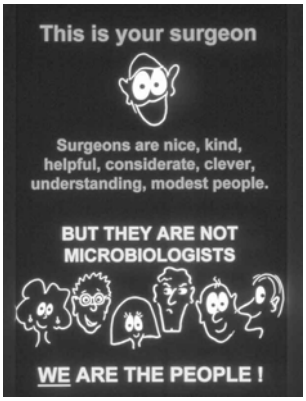

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