Healthcare workers and endemic / epidemic situations

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Question

• A new infection control nurse on her first day in your hospital has gone to the ICU following two new cases of MRSA being discovered in clinical specimens
• Your hospital has a policy of screening all staff in such a situation
• It is Monday morning and all the new staff arriving have been “off” for two days
• She screens ALL the nurses on duty and these new staff who cared for the positive patients before going off duty
• Was this wise?
  VOTE YES or NO
• What would you now do?
  Let’s discuss this during the lecture
Outline

Health care workers (HCW) and endemic / epidemic situations

• HCW as victims and “culprits”
• MRSA as an exemplar
HCW – Victims and “Culprits”

• Victims acquiring infection or colonisation e.g. norovirus, SARS, flu, hepatitis B, HIV

• Source of HCAI in their patients
  – From acquisitions in the community e.g. norovirus, flu
  – From onward transmission from patient, or via environmentally contaminated, sources
  – (From their own flora e.g. CNS: Under-investigated)
HCW – Routes of Transmission

• Airborne: covered by Stephan Harbarth
• Hand contact with patients or via equipment they contaminate
  – Infected, Colonised, Transiently contaminated
  – Many pathogens: major focus/exemplar MRSA
• Training and Behaviour critical: individual and organisational interventions e.g. audit/re-inforcement, consistent “champions,” belief in shared purpose, relevant competencies
Healthcare Workers and Endemic/Epidemic Organisms

• Hand contact is usual mechanism of cross-infection
  – Intrinsic organisms: Coagulase Negative Staphylococci, Diphtheroids
  – Extrinsic organisms: Endemic and Epidemic settings
    • Many Gram negative rods e.g. Klebsiella, Serratia
    • Enterococci
    • MRSA/MSSA
Five Steps of Hand Organism Patient to Patient Transmission*

(i) organisms present on a patient skin, or shed onto surrounding inanimate objects

(ii) must then be transferred to HCWs’ hands

(iii) and able to survive at least several minutes on HCWs’ hands

(iv) HCW hand washing/antisepsis inadequate, omitted or inappropriate agent used

(v) contaminated HCW hand(s) have direct contact, or with inanimate object that will direct contact with other patient(s)

*Adapted from WHO Hand Hygiene Guidelines Chapter 7
Step 1): organisms present on a patient skin, or shed onto surrounding inanimate objects

- Patients’ skin counts $10^2$ to $10^6$ CFU/CM$^2$ e.g. perineum, inguinal > other areas
- Drains, Wounds etc also high counts
- Risk factors for *S. aureus* carriage e.g. aged, diabetes, Chronic Renal failure, chronic dermatitis
- Shed $10^6$ skin squames/day: contaminate immediate environment
- Include e.g. staphylococci, enterococci, *Clostridium difficile*
- Gram negative rods “less resistant to desiccation”: except *Acinetobacter* more like a Gram positive
Step 2) : must then be transferred to HCWs’ hands

- Few data for patient-care activities
- Casewell & Phillips: 100–1000 CFU of *Klebsiella* spp. on nurses’ hands during “clean” activities: e.g. lifting patients; taking pulse, blood pressure or oral temperature; touching hand, groin.

- Pittet et al: fingertips ranged from 0 to 300 CFU after direct patient contact and respiratory tract care: 15% GNR 11% *S. aureus*

- **Duration of patient-care** activity associated with HCWs’ hand counts

- Gloves **vary in effectiveness** of preventing hand contamination
Step 3): able to **survive** several minutes on HCWs’ hands

- Gloved and ungloved patterns similar
- HCW’ hands progressively colonised + commensal flora & potential pathogens during patient care
- Bacterial contamination linear increases over time.
- Many organisms survive well:
  - 50% killing of epidemic/non-epidemic strains of *E.coli* at 6 min & *Kleb.* spp. at 2 minutes: **how long after that and infectious?**
  - *E. faecalis* & *E.faecium* viable >60 min.: gloved and ungloved
  - *Pseudomonas aeruginosa* and *Burkholderia cepacia*:
    - transmissible by handshaking
    - ~30 minutes in saline, and ~180m in sputum.
  - Rotavirus viable 16% at 20 min. & 2% at 60 min.
- Psoriatic dermatitis HCW: *Serratia marcescens* colonised >3 months
Step 4) : HCW hand washing/antisepsis inadequate, omitted or inappropriate agent used

- Covered by Benedetta Allegranzi
Step 5) : contaminated HCW hand(s) have **direct** contact, or with **inanimate** object that will **direct** contact with other patient(s)

- Transmission depends on:
  - Type of organism
  - Source
  - Destination surfaces
  - Moisture level
  - Size of inoculum.

- To clean paper towel transfer rates 0.01% to 0.64%
- From clean paper towel 12.4% to 13.1%
Step 5) contaminated HCW hand(s) have direct contact, or with inanimate object that will direct contact with other patient(s) *

- Norovirus sequentially transfer to up to seven clean surfaces
- Contaminated HCWs’ hands have been associated with endemic HCAIs
  - *S. marcescens* was transmitted from contaminated soap to patients via the hands of HCWs
  - GRE could be transferred from a contaminated environment or patients’ intact skin to clean sites via the hands of HCWs in 10.6% of contacts.

*Note that there are then issues of pathogenesis*
Prevention and Control

• Correct use of alcoholic hand rubs
• Soap and water for soiled hands, Norovirus and Clostridium difficile
• Greater focus on HH around mis-use of gloves (Fuller et al, 2011)
Fuller et al, Infect Control Hosp Epidemiol 2011;32:12 (December)

- >7K patient contacts: 56 ICU and Elderly wards in 15 UK hospitals including effects of gloves
- Hand Hygiene compliance only 50%
- When gloves worn it was lower (41%)
- Campaigns should emphasise better hand hygiene associated with gloving practices
- Critical step in getting overall hand hygiene to levels needed to prevent transmission of infection?
- (Not changing gloves between patients was not addressed)
Context is Everything!

• Different types of MRSA?
  – Healthcare Associated: HA MRSA
  – Community Associated: CA MRSA
  – Livestock Associated: LA MRSA

• Case mix e.g. High risk units e.g. ICU, Long Term Care Facilities (LTCF), Intensity of care

• Country occurrence of MRSA: Sporadic to Endemic to Hyper Endemic
Context is Everything!

- Healthcare Delivery
- Culture
- Attitudes
- Beliefs

Of:
Staff
Policy makers
Patient/advocates.
Cultural Differences

Traffic Lights

– In England they are Mandatory
– In France they are Suggestions
– In Italy they are Christmas Decorations
Context is Everything!

• Healthcare Delivery
  – Staff/Patient ratios
  – Intensity of patient care
  – Bed occupancy
  – Local/Regional availability of healthcare e.g. neurosurgery
  – “Maturity” of their Infection Prevention and Control Programmes (IPSE WP2/EC Recommendations)
    etc etc
Types of HCW screening

1) Outbreak-related
   Many views and approaches:
   - Epidemiologically informed: linkage of specific staff to MRSA acquisitions/infections: easier to identify when low occurrence or patient screening in place
   - Following initial visual inspection and questioning e.g. UK
   - All are screened routinely e.g. the NL
   - All are screened routinely on high risk units …. 

I am an advocate of patient screening to validate intervention measures (discharge and long stay patients : >7-10d))
Types of HCW screening

2) Anonymous to encourage improved hand hygiene or increase awareness
3) Pre employment: universal/exposure history
4) Agency staff screening
5) To plan MRSA eradication regimens
6) Post treatment clearance screening
HCW: Classification of MRSA Positive

1) Infected
2) Persistently Colonised
3) Transient or Short Term carriage

Note: there is little or no evidence that GRE and GNRs staff carriage is significant in its spread
1) MRSA Infections in HCWs
Albrich and Harbarth, 2008

- 48 (5.1%) of 942 surveyed health-care workers had symptomatic MRSA infection without reported fatalities.
- Skin or soft tissue infections commonest e.g. eczema, paronychia
- Upper respiratory tract infections: sinusitis, viral (“cloud adult”)
- Data probably relate to outpatients (Occupational Health)
- One HCW with Cystic Fibrosis acquired MRSA post-operatively as a patient.
Infection is Uncommon for Classical Hospital Acquired MRSA
2) MRSA HCW persistent carriage

- Usually do not state when HCW were screened related to duty
- There is general ignorance of this point (personal view!)
- Albrich and Harbarth, 2008: 104 studies: nasal MRSA HCW carriage 4.1% (range 0–59%)
  - Chronic sinus conditions/Hay fever/Deflected nasal septa/Polyps etc
- Other sites less reported and often only when nasal positive/recurrent/failed treatment
  - MRSA found on hands - 6.4% (24 studies): perineum-1.6%: (7) pharynx- 0.3% (4)
  - Perineum: All four quadrants; Faeces/Rectal? Why groin?
  - Pharynx: Oral/Dentures/Buried roots etc
- Hair and Fingertip carriers: useful extra sites for dispersers
- Skin conditions e.g. eczema, psoriasis
Persistent Colonisation of Bitten Fingernail beds and Cuticles

3) Short Term and Transient Carriage
• Isolation ward for UK EMRSA-1 outbreaks St Thomas’ hospital
• Followed observation that repeated screening of staff on duty ~25% positive compared to <1% off duty
• 26 nurses SELF screened nose and fingertips immediately before and after duty periods in which they solely attended six patients widely colonized with two EMRSA strains distinguishable by plasmid analysis (stable cryptic plasmid).
• Broth enrichment used
• 13 (50%) were carriers

• **Transient carriage** in 12 (46%) nurses: EMRSA isolated from noses or fingers of nurses after duty: non recoverable before their next day's duty

• **Short-term nasal carriage**: 4 (15%)
  EMRSA carriage was detected on two consecutive screens (end day and next morning)

• **Persistent nasal carriage**: 1 nurse
  EMRSA detected >two consecutive occasions. UTI on amoxycillin treatment and chlorhexidine perineal “reaction”
Transient or short-term carriage in nurses

- All but one explained by close contact “Grade 3” activities generating aerosols e.g. dressings
- Occurred despite an intensive control programme & self screening!
- Resulted in transfer of EMRSA between patients.
- Introduced masks thereafter
- Effects not studied: Minnesota MRSA Guidelines later recommended them for aerosol producing procedures (Bennett et al, 1992)
Grade Three activities e.g. dressing of wounds resulted in transient contamination of healthcare workers and onward transmission of MRSA.

As opposed to casual contact (Grade One) or Grade Two activities with intensive patient contact, but no manipulation of colonised or infected sites.
Effect of Masks on Transient Carriage in EMRSA-16

Lacey et al, J Hosp Infect, 2001;48: 308-311

• Repeated Cookson et al, 1999 work
• Transient carriage seen in 13/27 (48.1%)
• Masks were then worn (1.0 micron particles: Universal pleated face masks, Technol, UK)
• Reduced transient carriage 7/27 (25.9%)
• Nose and Throat reduced (not sig) but when combined with Fingers it was
• “Grade 1 procedures also important on their isolation unit” but unclear whether apparent in the study
“Often implicated in cross infection where no carriers and environment negative” – 5 studies

False labelling staff as carriers and decontaminating them

Two studies showed patient MRSA transfer to gloves of HCWs 15% and 17% of occasions

Hand hygiene compliance and staffing workloads related to hand contamination
How often do Asymptomatic HCWs cause MRSA outbreaks: A Systematic Evaluation?
Vonberg et al, ICHE 2006: 27;1123-27

- PubMed search: Jan, 1966 - August 30, 2005
- Inclusion and exclusion criteria:
  - If specific employee had introduced a new MRSA strain
  - If controlled studies revealed an individual HCW significant risk factor for MRSA acquisition, and outbreak ceased after HCW removal from duty.
  - Excluded if HCW nasal carriage considered as one of possible causes of the outbreak
  - All outbreaks evaluated based on molecular typing and epidemiological data
Asymptomatic HCW and MRSA Outbreaks
Vonberg et al, ICHE 2006: 27;1123-27

- 191 Outbreak abstracts identified: 165 from Outbreak database; 26 PubMed/hand searches
- 26 (14%) studies reviewed
- 11 (6%) strong evidence a HCW was outbreak source
- 8/11 outbreaks molecular typing was used.
- Asymptomatic HCW carriers in “only 3” (1.6%) outbreaks
Symptomatic HCW and MRSA Outbreaks
Vonberg et al, ICHE 2006: 27;1123-27

- 8/11 outbreaks HCWs were “infected”
- 4: Respiratory (sinusitis, URTI, LRTI)
- 4: Skin infections (dermatitis/eczema)
- HCWs proportion screened who had MRSA strains ranged from 1.6% (cloud adult) to 21.4% (sinusitis)
Personal view:
Why do they not mention screening of patients e.g. on discharge and in longer term e.g. >7-10 days?

• Do not focus on screening for asymptomatic carriage (“only” 1.6% of 191 MRSA outbreaks)
• Focus on infected HCWs (4.2%)
• Education of staff, sufficient alcohol-based hand disinfection, and early placement of MRSA-positive patients in isolation remain the most important methods for limiting nosocomial MRSA spread
“Issues”
- PubMed missing outbreak reports
- Sporadic transmission from chronic MRSA HCW colonisation not addressed
- Publication biases: Not admit bad practices/Greater public interest.
- **Were staff screened on duty?**
- Molecular typing not available so may overestimate
- Epidemiological data not inform direction of spread
- Diversity of MRSA strains is low: interpretation issues: sequencing?
- Infection and Death causation not defined

Advocate use of “ORION” criteria!
Albrich and Harbarth
Lancet Inf Dis 2008; 8:289-301

• Non systematic but thorough review
• Not just outbreak related
• 169 articles: 37 countries: high income
• 102 Outbreaks: 29 PPS: 32 Prospective studies: 6 case reports
• Hospital and LTCF
• 4.6% of 33,318 HCWs positive (0 [18 studies]-59%)
• ONLY two of these 18 in endemic setting
Albrich and Harbarth
Lancet Inf Dis 2008; 8:289-301

• Risk Factors in > 40 studies (all types)
• 3 Studies: Poor infection control practices were implicated in both acquisition and transmission of MRSA by personnel
• Even good adherence to infection control (including masks) and hand hygiene did not entirely prevent transmission of MRSA from **heavily colonised staff** to patients (1 study)
• 10 studies no risk factors for MRSA colonisation.
Risk Factors for HCW MRSA
Albrich and Harbarth, 2008

Panel 1: Risk factors for MRSA in health-care workers

MRSA carriage
Comorbidities
- Cutaneous lesions or conditions (eg, dermatitis, eczema, psoriasis, pemphigus)\textsuperscript{14,20-44}
- Sinusitis, rhinitis (chronic, allergic, infectious)\textsuperscript{12,40-41}
- Chronic otitis externa, earlobe dermatitis\textsuperscript{40,42,90}
- Recent urinary tract infection\textsuperscript{21}
- Cystic fibrosis\textsuperscript{13}

Other endogenous factors
- Recent antibiotic use\textsuperscript{14,40,51,61}

Work-related factors
- Previous work abroad\textsuperscript{14,41,61}
- Work experience (eg, student health-care worker, longer duration of service)\textsuperscript{40,48,97}
- Area of service (eg, medicine, surgery, long-term care facilities, decreasing risk from ward to ICU to operating theatre)\textsuperscript{90,91}
- Employment in areas of high patient MRSA prevalence\textsuperscript{40,89} (eg, patients from high-prevalence countries)\textsuperscript{42,43,44,46,60,81}
- Close contact with patients (eg, dressing changes, wound contact)\textsuperscript{11,44,45,61,66}
- Poor attention to infection control (eg, poor hand hygiene)\textsuperscript{14,61,111}
- High work load\textsuperscript{44}

MRSA persistence despite eradication
- Comorbidities: cutaneous lesions/conditions\textsuperscript{10,40}
- Sites of colonisation: pharynx, rectum, perineum, extensive skin\textsuperscript{40,44,46,60}
- Household and environmental contamination\textsuperscript{90,91}
- Mupirocin resistance\textsuperscript{44}

Relapse after eradication
- Sites of colonisation: pharynx, rectum, genitals (vagina, prepuce), skin, ear lobes\textsuperscript{90,91,60}
- Infections: upper respiratory tract infection, chronic otitis externa\textsuperscript{40,42,90}
- Mupirocin resistance\textsuperscript{44}
HCW transmission of MRSA to patients and close contacts
Albrich and Harbarth, 2008

- In 106 studies using molecular techniques and good epidemiology: 27 (25%) “good” evidence and 52 (50%) “likely” transmissions to patients
- Likely transmission no clinical or sub clinical staff infection (but unclear whether screening during duties)
- Carriage rates varied in same MRSA (E-16: 0.9-5.0%)
  - Outbreaks with several phases and many complexities
  - Outbreaks can start with a transferred HCW to a unit
  - Then transient spread then another HCW infected
- Halting an outbreak: one of several interventions was removing the affected HCW from duty
Role in Endemic MRSA
Albrich and Harbarth, 2008

• “Rates of Staff MRSA carriage higher (8.1%) than in outbreaks (3.9%)”
• Again when were they screening?
• Related to rubric of understaffing, poor hand hygiene compliance and overwhelmed resources
MRSA HCW Family Transmission
Albrich and Harbarth, 2008

- 8 Studies
- 29% incidence of transmission found in one study (Eveillard et al, 2004)
- Home contaminated e.g. Masterton et al, 1995, Kniehl et al, 2005
- 1 study found none (and neither was this found for EMRSA-1 in North London: unpublished Royal Free)
- Can result in further spread within the hospital
Is “Rubric” changing?

- MRSA types are changing and the context in which they are seen:
- Pet MRSA – “victims” usually: may be important Kniehl et al, 2005
- Livestock associated MRSA
- CA MRSA
Netherlands: HCWs risk from Livestock MRSA
Wulf et al, J Hosp Infect 2008;70:186-190

• MLST ST398 related spa types found in pig farmers, pig veterinarians and pigs in several other countries too
• 3% Dutch hospitals’ HCWs serving rural populations belong to a “high risk group for MRSA carriage” (Guidelines)
• 1721 HCWs in 4 DGHs and 1 Teaching Hospital cultured nose and throats
• 77/1721 (4.4%) : direct or indirect contact with pigs and/or veal calves: 1.7% were positive
• 145/1721 (%) reported contact with other livestock animals: 0% were positive
• Controls 0.15% positive not statistically less than 1.7%
CA MRSA

- Albrich and Harbarth (2008) review:
  - 14 Epidemic/Endemic investigations with CA-MRSA, 70/2002 (3.5%) and 5/59 (8.5%) were symptomatic.
  - HIV outpatient clinic outbreak: environment contamination: 3/70 (3%) HCWs infected with patient contact; 2/138 (2%) HCWs nasal carriage
  - German LTCF 6/104 (6%) CA HCW MRSA found
  - “Similar rates to HA MRSA but infections commoner”

- UK Outbreak where Philippines CA MRSA prevalent in HCWs and families resulted in some spread to hospitalised patients as well as auto-infection (Orendi et al, *J Hosp Infect*. 2010; 75:258-64)
Conclusions (Comments)

1) Agreement with:
   - Infected HCW can spread MRSA to patients
     - Examination /Questioning of staff
     - HCW screening if aware of links with patient MRSA/New/Virulent MRSA
Conclusions (Comments)

2) Disagreement that:
Need to consider asymptomatic HCWs as a cause of spread in Outbreak settings

- Vonberg et al found just 3, but Albrich and Harbarth 18 proven and 26 likely, outbreaks with HCW to patient transmission to (probably relates to inclusion criteria)
- Low occurrence MRSA countries (NL, Perth, Scandinavia..)
- Albrich and Harbarth also state for endemic situations (where there is a trend for higher colonisation rates in settings with endemic MRSA).

However, it is unclear how much is simply short term carriage
Conclusions: Albrich and Harbarth

3) Focus on high risk units in endemic settings as costs need to be considered.
   Why not advocate patient screening?

4) HCW undergoing surgical procedures should be evaluated for MRSA carriage and potential eradication.

5) Endemic settings: periodically and unannounced before a work shift to avoid detecting only transient carriers. There will be instances of short term carriage so after period off duty better. Again my view would be to focus more on patient screening!

6) Nasal screening: differences of opinion on throat screening “Perhaps ICU differs from other wards” (in that Nasal swabs sufficient)?
Question

- A new infection control nurse on her first day in your hospital has gone to the ICU following two new cases of MRSA being discovered in clinical specimens.
- Your hospital has a policy of screening all staff in such a situation.
- It is Monday morning and all the new staff arriving have been “off” for two days.
- She screens ALL the nurses on duty and these new staff who cared for the positive patients before going off duty.
- Was this wise? Vote YES or NO.

What would you now do? To discuss