Gentamicin and Vancomycin (GaV) Quality Improvement Programme

Yvonne Semple
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Healthcare Improvement Scotland Research Symposium
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Background

- Gentamicin and vancomycin are antibiotics used to treat life-threatening infections.
  - low doses are ineffective
  - high doses cause toxic effects
  - require therapeutic drug monitoring (measure of drug concentration in the blood)

- Guidelines were introduced by Scottish Antimicrobial Prescribing Group in 2009
  - for calculating initial doses of gentamicin and vancomycin
  - for interpreting plasma concentrations

- Quality improvement programme aimed to:
  - assess the impact of implementing new guidelines
  - better understand the unintended consequences
  - describe patient safety issues that arise through implementation
## Project Team

- **SAPG (Information and Infection Management workstream)**
- **University of Strathclyde**

### Principal Investigators

- **Professor Marion Bennie**  
  NSS Chief Pharmaceutical Advisor / Professor of Pharmacy Practice, University of Strathclyde

- **Dr Alison Thomson**  
  Area Pharmacy Specialist, NHSGGC / Senior Lecturer, University of Strathclyde

### Project Lead

**Yvonne Semple**  
Lead Pharmacist, CE NHSGGC

### Clinical Researcher

**Stephen Dewar**  
Clinical Pharmacist, NHSGGC

### Qualitative Researcher

**Dr Rosemary Newham**  
PhD Social Sciences

### Statistical Analyst

**Tracey Cromwell**  
Principal Information Analyst, ISD
Collaborative working

Scottish Antimicrobial Prescribing Group (SAPG)

Association of Scottish Antimicrobial Pharmacists

University of Strathclyde

NHS frontline clinicians (doctors & pharmacists)
GaV Quality Improvement Programme: completed work

- **Study 1**
  - National survey to establish use of guidance and local implementation strategies (December 2010)

- **Study 2**
  - National point prevalence study to determine appropriateness of gentamicin and vancomycin prescribing and monitoring

- **Study 3**
  - Qualitative study to assess how fit for purpose guidance is in supporting front-line clinicians
Study 2  Point Prevalence Study, all boards Feb – May 11

<table>
<thead>
<tr>
<th>Prevalence</th>
<th>Gentamicin (n = 140)</th>
<th>Vancomycin (n = 80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.2%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Range</td>
<td>0.2 - 5.3%</td>
<td>0.5 - 2.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient details</th>
<th>Gentamicin (n = 140)</th>
<th>Vancomycin (n = 80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>62 (19)</td>
<td>63 (17)</td>
</tr>
<tr>
<td>Weight &gt; ± 20% IBW</td>
<td>57%</td>
<td>51%</td>
</tr>
<tr>
<td>Creatinine (µmol/L)</td>
<td>99 (81)</td>
<td>115 (98)</td>
</tr>
<tr>
<td>Creatinine CL (ml/min)</td>
<td>80 (44)</td>
<td>78 (44)</td>
</tr>
<tr>
<td>Nephrotoxic drug</td>
<td>27%</td>
<td>37%</td>
</tr>
<tr>
<td>Liver impairment</td>
<td>13%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Data are mean (SD) or %

Results: prescribing documentation

- Kardex alone 26% gent 41% vanc
- Kardex and local prescribing chart 37% gent 23% vanc
- Variety of combinations used

GaV Quality Improvement Programme
Study 2  Point Prevalence Study, all boards Feb – May 11

Results: initial gentamicin dose

Dose correct in 61% of patients: 14% below, 25% above

GaV Quality Improvement Programme
Study 2 Point Prevalence Study, all boards Feb – May 11

Results: initial vancomycin loading dose

Dose correct in 65% of patients: 29% below, 6% above

GaV Quality Improvement Programme
Gentamicin blood concentration should be measured ideally 6 – 14 hours after the dose is given.

Results from study showed around 70% of samples measured at the correct time.
Study 3 qualitative, 4 boards

- Ayrshire & Arran, Greater Glasgow & Clyde, Highland, Lothian
  - two large, two small hospitals
  - focus groups: 5 – 8 pharmacists (27)
    4 – 8 junior doctors (23)
  - interviews: 9 senior doctors

- How fit for purpose are the current SAPG guidelines in supporting front-line staff?
Study 3: Qualitative

Results: themes

• Two types of themes emerged to explain barriers to effective initial prescribing and therapeutic drug monitoring.

• Firstly, barriers arose from the content of the guidelines – clinicians required experience to interpret and apply them effectively.

• Secondly, barriers resulted from a failure in the context in which the guidelines functioned. Including insufficient dissemination, communication issues within the hospital site, unmet educational needs for effective use of the guidelines and staffing issues.
Study 3: Qualitative

Results: themes

- **Two types** of themes emerged to explain barriers to effective initial prescribing and therapeutic drug monitoring.

- **Firstly**, barriers arose from the **content** of the guidelines – clinicians required **experience** to interpret and apply them effectively.

- **Secondly**, barriers resulted from a failure in the **context** in which the guidelines functioned. Including insufficient dissemination, communication issues within the hospital site, unmet **educational needs** for effective use of the guidelines and staffing issues.
Recommendations

- Develop standardised documentation
- Update SAPG GaV guidance
- Develop an educational resource
- Develop an online calculator for use with Hartford nomogram
- Online calculator – save patient specific data
Actions

- Formal report to SAPG and Scottish Government
- Presentation of results at SAPG Antimicrobial Management Team (AMT) events
- Workshops at AMT events to inform recommendations
- Expert multidisciplinary steering group to develop outputs
  - Yvonne Semple, Stephen Dewar and Dr Alison Thomson (GaV team)
  - Mr William McGregor (Lothian)
  - Dr Stephanie Dundas (Lanarkshire)
  - Dr Andrew Seaton (GGC)
  - Mrs Alison MacDonald (Highland)
  - Mrs Susan Roberts (Dumfries & Galloway)
Recommendations

• Develop standardised documentation

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**ADULT PARENTERAL GENTAMICIN (GGC): PREScribing, ADMINISTRATION & MONITORING CHART**

Use for all patients prescribed intravenous gentamicin unless prophylactic indication or synergistic doses (usually in combination) are being used.

**Patient name:** ..........................................................

**Date of birth:** ..........................................................

**CHI no.:** ..........................................................

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**PROMPT ADMINISTRATION**  
within 1 hour of recognition of sepsis reduces mortality

**SIGNS OF GENTAMICIN TOXICITY**  
RENAL: ↓ urine output/oliguria or ↑ creatinine  
OTO/VESTIBULAR: hearing loss, oscillating vision

Toxicities may occur irrespective of gentamicin concentration.

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**PRE-SCRIBING CHECKS**

- **Toxicity assessments**
  - Before prescribing:
  - Check renal and oto/vestibular function

**Gentamicin Prescription Record**
- Complete each time a dose is given (ensuring gentamicin is prescribed ‘as per chart’ on the kardex)

**Administration Record**
- Complete each time gentamicin is administered (in addition to the kardex)

**Monitoring Record**
- Record ALL sample dates/times accurately below. See overleaf for monitoring advice.

<table>
<thead>
<tr>
<th>Toxicity Assessments</th>
<th>Date to be given</th>
<th>Time to be given 24 h clock</th>
<th>Gentamicin Dose (mg)</th>
<th>Prescriber’s signature, PRINTED name and STATUS</th>
<th><em>Infuse over 30 mins</em></th>
<th>Date given</th>
<th>Time started 24 h clock</th>
<th>Given by</th>
<th>Date of sample</th>
<th>Time of sample 24 h clock</th>
<th>Gent level (mg/L)</th>
<th>Action/Comments (please initial action to be taken)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before prescribing:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 hourly □ 48 hourly □ Withhold □ Stop □ Details/other:</td>
</tr>
<tr>
<td>Check renal and oto/vestibular function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 hourly □ 48 hourly □ Withhold □ Stop □ Details/other:</td>
</tr>
</tbody>
</table>

*Discuss with an infection specialist and document in the notes if treatment continues beyond 3 to 4 days*

**Risks of prolonged treatment must be considered and treatment options discussed with microbiology or infection specialist**

*Discuss with an infection specialist before continuing onto a second sheet*
Recommendations

• Develop standardised documentation
• Update SAPG GaV guidance
• Develop an educational resource
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• Online calculator – save patient specific data
Gentamicin scenarios

- ototoxicity
- prolonged therapy
- septic patient creatinine unknown
- delayed dose administration
- obese normal renal function
- decline in renal function
Vancomycin scenarios

- obese
- administration rate
- basic principles
- delayed dose administration
- inappropriate sample time
- incorrect dose interval
This item is broken down into Topics. Please select a Topic from the list below.

To return to the full list of learning click LEARN.

For assistance using learnPro NHS please visit the Support Site
If the creatinine clearance (CrCl) is $\geq 21$ mL/min:

- Take a blood sample 6 - 14 hours after the start of the first infusion
- Record the gentamicin concentration on the gentamicin prescribing chart
- Plot the gentamicin concentration against the sample time (from the start of the infusion) on the graph and reassess the dosage regimen as required

If the measured concentration is below this curved line, give the same dose every 24 hours.
Mr C is 53 years old, weighs 92 kg and his height is 170 cm. His latest serum creatinine concentration is 87 micromol/L.

Assessed

Question 3.1
What loading dose of vancomycin would you give to Mr C?
- 750 mg
- 1000 mg
- 1500 mg
- 2000 mg

Q 3.2
Using sodium chloride 0.9%, in what volume and over how long should the loading dose be administered via a peripheral IV line?
- 2000 mg in 250 mL over 2 hours
- 2000 mg in 500 mL over 3 hours
- 2000 mg in 250 mL over 4 hours
- 2000 mg in 500 mL over 4 hours
Recommendations

• Develop standardised documentation

• Update SAPG GaV guidance

• Develop an educational resource

• Develop an online calculator for use with Hartford nomogram

• Online calculator – save patient specific data
# Gentamicin Calculator (Hartford Regimen) for Adult Patients

<table>
<thead>
<tr>
<th>Type in the data shown in blue and press &lt;enter&gt;</th>
<th>Recommended dose is shown in black below</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td><strong>Dose</strong></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td><strong>Duration of infusion</strong></td>
</tr>
<tr>
<td><strong>OR Height (feet)</strong></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>(inches)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td><strong>Sampling time</strong></td>
</tr>
<tr>
<td>55.0</td>
<td></td>
</tr>
<tr>
<td><strong>Sex (m/f)</strong></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td></td>
</tr>
<tr>
<td><strong>Creatinine (μmol/L)</strong></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td></td>
</tr>
<tr>
<td>157</td>
<td></td>
</tr>
<tr>
<td><strong>Ideal body weight (kg)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Weight for creatinine clearance (kg)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Creatinine CL (ml/min)</strong></td>
<td></td>
</tr>
</tbody>
</table>

## Gentamicin 7 mg/kg (Hartford) Dosage Regimen

**Review antimicrobial therapy daily**

*Seek advice from microbiology if gentamicin is required beyond 3 - 4 days*
## Gentamicin Calculator (Hartford Regimen) for Adult Patients

<table>
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<tr>
<th>Type in the data shown in blue and press &lt;enter&gt;</th>
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<tr>
<td><strong>Gentamicin 7 mg/kg (Hartford) Dosage Regimen</strong></td>
<td></td>
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<tr>
<td>Age (years)</td>
<td>25</td>
</tr>
<tr>
<td>Height (cm)</td>
<td></td>
</tr>
<tr>
<td>OR Height (feet)</td>
<td>5</td>
</tr>
<tr>
<td>(inches)</td>
<td>2</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.0</td>
</tr>
<tr>
<td>Sex (m/f)</td>
<td>f</td>
</tr>
<tr>
<td>Creatinine (μmol/L)</td>
<td>75</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>157</td>
</tr>
<tr>
<td>Ideal body weight (kg)</td>
<td>50.1</td>
</tr>
<tr>
<td>Weight for creatinine clearance (kg)</td>
<td>55.0</td>
</tr>
<tr>
<td>Creatinine CL (ml/min)</td>
<td>87.7</td>
</tr>
<tr>
<td><strong>Dose</strong></td>
<td>400 mg</td>
</tr>
<tr>
<td><strong>Duration of infusion</strong></td>
<td>60 mins</td>
</tr>
<tr>
<td><strong>Sampling time</strong></td>
<td>Take a sample 6-14 hours after the first dose and refer to Hartford nomogram for dosing interval</td>
</tr>
<tr>
<td><strong>Review Antimicrobial Therapy Daily</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Seek advice from microbiology if gentamicin is required beyond 3 - 4 days</strong></td>
<td></td>
</tr>
</tbody>
</table>

Print Calculator Record
What next?

Research Topic
Quality improvement of antibiotics with a narrow therapeutic index

Supervisors
Dr A Thomson, Professor M Bennie (University of Strathclyde)
Professor P Davie (University of Dundee)

SIRN-CSO Fellowship
Quality improvement of antibiotics with a narrow therapeutic index

R1. What is the **uptake** and **impact** of the new national GaV educational resource and documentation?

R2. What is the **effect** of different **quality improvement interventions** on the use of gentamicin and vancomycin?

R3. What **dosage regimens and monitoring approaches** are required to ensure that target concentrations of gentamicin and **vancomycin** are achieved in a paediatric population?
Acknowledgements

• GaV Project Team
• SAPG
• ASAP members
• GaV expert working group
• NHS colleagues (data collection / provision)