Facilitating early discharge through IV oral switch

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IV or Oral?
UK NHS (England) Health statistics

- 14 million people are admitted to hospital each year and the
- NHS treats a million people every 36 hours.
- In 2009-10, total of 1,899 MRSA bacteraemias
- 25,605 *C. difficile* infections.
Men’s emergency ward. East London 1860’s

Florence Nightingale, Scutari, 1850
Women’s ward, Scotland 1955

Crowded maternity ward
Philippines
Home - an improvement?
Hospital or Home Care

- **Hospital**
  - Expertise
  - Close observation
  - Monitoring
  - Expensive
  - HC complications

- **Home**
  - Patient preference
  - More comfortable
  - Improved recovery
  - Less monitoring or observation
Patients/carers can have greater control over their condition and therapy

Improved patient dignity

Freedom from social isolation

Less risk of developing psychological problems due to boredom

Improved nutrition/hydration

Less sleep deprivation

Less risk of developing pressure sores

Less risk of contracting or transmitting infection

Once discharged can allow the patient to lead as an as near “normal” life as possible
**IV OPAT or oral**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Home environment</td>
<td>* Disruption to home life</td>
</tr>
<tr>
<td>* Continued attendance at work/school</td>
<td>* Stressful for family</td>
</tr>
<tr>
<td>* Reduced risk of HCAI</td>
<td>* Compliance</td>
</tr>
<tr>
<td>* Better use of hospital beds</td>
<td>* Misuse of IV access</td>
</tr>
<tr>
<td>* Patient empowerment</td>
<td>* Decreased supervision</td>
</tr>
<tr>
<td>* Reduced HC costs</td>
<td>* Access to emergency care</td>
</tr>
</tbody>
</table>

% Patients over 80 in European HC facilities

Length of hospital stay and duration of therapy

- In many countries, hospital length of stay is longer than duration of therapy

Early switch is recommended if all inclusion criteria are fulfilled, all exclusion criteria are absent and if an appropriate oral regimen is available.

### Eligible for oral switch
- Intravenous antibiotics for >24 hours
- Afebrile (temperature <38°C) for >24 hours
- Clinical improvement or stable infection
- WBC count normalizing, WBC of $4 \times 10^9/L$ to $12 \times 10^9/L$
- No unexplained tachycardia
- Systolic blood pressure ≥100 mm Hg
- Patient tolerates oral fluids/diet and is able to take oral medications with no gastrointestinal absorption problems

### Not eligible for oral switch
- Haematological malignancies or neutropenia
- Cutaneous abscess not treated with incision and drainage; severe soft tissue infection; osteomyelitis; septic arthritis
- Central nervous system infection or intravascular infection (e.g. suppurative thrombophlebitis)

### Eligible for early discharge
- All early switch eligibility criteria listed above have been met
- No other reason to stay in hospital except for infection management
- Stable mental status
- Stable comorbid illness
- Stable social situation

Who should facilitate IV/oral switch?

- Clinical team/ AMT/OPAT team?
- Patient selection
- Antimicrobial management and drug delivery
- Monitoring of the patient during OPAT
- Outcome monitoring and clinical governance

ORAL TREATMENT IN OPAT

Pharmacokinetics of oral antibiotics

<table>
<thead>
<tr>
<th>Group, agent</th>
<th>Absorption (%)</th>
<th>Usual dosage</th>
<th>Peak serum level (mg/L)*</th>
<th>Protein binding (%)</th>
<th>Serum half-life (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>74–92</td>
<td>500 mg q8h</td>
<td>3.5–5.0</td>
<td>17–20</td>
<td>1</td>
</tr>
<tr>
<td>Amoxicillin/clavulanate</td>
<td>60</td>
<td>500 mg q8h</td>
<td>3.7–4.8</td>
<td>18–25</td>
<td>1</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>30–55</td>
<td>500 mg q6h</td>
<td>6</td>
<td>20</td>
<td>0.7–1.4</td>
</tr>
<tr>
<td>Dicloxacillin</td>
<td>35–76</td>
<td>500 mg q8h</td>
<td>10–18</td>
<td>75–97</td>
<td>0.3–0.9</td>
</tr>
<tr>
<td>Penicillin</td>
<td>60–73</td>
<td>500 mg q6h</td>
<td>4.9–6.3</td>
<td>75–89</td>
<td>0.5</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalaxin</td>
<td>90–100</td>
<td>500 mg q6h</td>
<td>15–18</td>
<td>10–19</td>
<td>0.6–1.3</td>
</tr>
<tr>
<td>Cephradine</td>
<td>90–95</td>
<td>500 mg q6h</td>
<td>15–18</td>
<td>10–19</td>
<td>0.6–1.3</td>
</tr>
<tr>
<td>Cefaclor</td>
<td>&gt;52–95</td>
<td>500 mg q6h</td>
<td>13–15</td>
<td>20–25</td>
<td>0.6–1</td>
</tr>
<tr>
<td>Cefprozil</td>
<td>71–95</td>
<td>500 mg q12h</td>
<td>8.2–10.4</td>
<td>36–45</td>
<td>0.9–1.4</td>
</tr>
<tr>
<td>Cefuroxime axetil</td>
<td>30–52</td>
<td>500 mg q12h</td>
<td>7</td>
<td>33–50</td>
<td>1–2</td>
</tr>
<tr>
<td>Cefixime</td>
<td>30–50</td>
<td>400 mg q24h</td>
<td>3.7–4.8</td>
<td>48–69</td>
<td>3.1–3.8</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>29–53</td>
<td>400 mg q12h</td>
<td>3.9–4.5</td>
<td>18–30</td>
<td>2.2–2.8</td>
</tr>
<tr>
<td>Loracarbef</td>
<td>90</td>
<td>400 mg q12h</td>
<td>14</td>
<td>25</td>
<td>0.7–1</td>
</tr>
<tr>
<td>Macrolides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azithromycin</td>
<td>37</td>
<td>500 mg q24h</td>
<td>0.04–0.4</td>
<td>7–50</td>
<td>35–72</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>55</td>
<td>500 mg q12h</td>
<td>0.6–1.3</td>
<td>42–70</td>
<td>4.3–7</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Depends on salt of drug used</td>
<td>500 mg q6h</td>
<td>0.3–3.8</td>
<td>65–90</td>
<td>1.5–3</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxycycline</td>
<td>&gt;90 with food</td>
<td>200 mg q12h</td>
<td>2.5</td>
<td>90</td>
<td>18</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>&gt;90 with food</td>
<td>500 mg q12h</td>
<td>3.5</td>
<td>65</td>
<td>8</td>
</tr>
<tr>
<td>Quinolones</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>65–85</td>
<td>500 mg q12h</td>
<td>2.5</td>
<td>15–40</td>
<td>3.5–6</td>
</tr>
<tr>
<td>Ofloxacin</td>
<td>98</td>
<td>400 mg q12h</td>
<td>5.5</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Lomefloxacin</td>
<td>90–98</td>
<td>400 mg q24h</td>
<td>3–4.7</td>
<td>10</td>
<td>7–8</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>75–90 (drug base)</td>
<td>500 mg q6h</td>
<td>10–13</td>
<td>25–60</td>
<td>1.5–3.5</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>90</td>
<td>300 mg q6h</td>
<td>3.6</td>
<td>94</td>
<td>2–3</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>80</td>
<td>500 mg q8h</td>
<td>11.5</td>
<td>&lt;20</td>
<td>5–10</td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>70–90</td>
<td>160 mg/800 mg</td>
<td>1–2/40–60</td>
<td>44/70</td>
<td>8–11/10–13</td>
</tr>
</tbody>
</table>

Clinical Infectious Diseases 1997; 24:457–67
77 year old man
Peripheral vascular disease
Large ischaemic ulcers
Non healing

Heavily colonised with coliforms, MRSA, VRE and Pseudomonas aeruginosa.
The Eron and CREST Severity Classification Systems for the Treatment of Cellulitis in UK

<table>
<thead>
<tr>
<th>Class</th>
<th>Eron(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>afebrile and healthy, other than cellulitis</td>
</tr>
<tr>
<td>II</td>
<td>febrile and ill appearing, no unstable comorbidities</td>
</tr>
<tr>
<td>III</td>
<td>toxic appearance, or at least 1 unstable comorbidity, or limb-threatening infection</td>
</tr>
<tr>
<td>IV</td>
<td>sepsis syndrome or life-threatening infection, e.g. necrotising fasciitis</td>
</tr>
</tbody>
</table>

2. CREST Guidelines 2005

OPAT = outpatient parenteral antibiotic therapy

Adapted from Eron et al, 2003.

SEWS: standardised early warning score
Empirical treatment – 189 hospitalised patients with SSTI

Early discharge – a better approach for managing infection?

IV
oral
Duration of IV Therapy in a study of MRSA soft tissue infection

The mean duration of IV therapy at EOS was significantly shorter in the linezolid group than in the vancomycin group.

- **Linezolid 600mg IV/PO q12h**
- **Vancomycin 15 mg/kg IV q12h**

<table>
<thead>
<tr>
<th></th>
<th>PP</th>
<th>mITT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linezolid</td>
<td>5.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>10.4</td>
<td>9.8</td>
</tr>
</tbody>
</table>

* Vancomycin dose adjusted for creatinine clearance and trough levels

Length of Stay

The mean length of hospital stay at EOS was significantly shorter in the linezolid group than in the vancomycin group\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>Linezolid 600mg IV/PO q12h</th>
<th>Vancomycin 15 mg/kg IV q12h*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean length of stay, days</strong></td>
<td>7.6</td>
<td>7.7</td>
</tr>
<tr>
<td>PP</td>
<td>8.9</td>
<td>3.9</td>
</tr>
</tbody>
</table>

\(P=0.022\)

\(P=0.016\)

* Vancomycin dose adjusted for creatinine clearance and trough levels

GOing Home Study

Glycopeptides to Oral treatment at HOME study

Hammersmith and Charing Cross Hospitals, London

Wendy Lawson, Lead Pharmacist Infectious Diseases, Hammersmith Hospital
Results

52% patients had intervention made

155 patients on IV glycopeptide

- 64 (41%) D’charged on oral antibiotic*
  - 50 (78%) Initiated by Study team
  - 14 (22%) Initiated by Patient’s team

- 91 (59%) Stayed in hospital
  - 17 (11%) Switched to oral antibiotic

Savings

0.5 FTE Antibiotic Pharmacist

Post Discharge Follow Up

- Patient’s GP informed about study recruitment
- All patients reviewed by telephone by SP at end of antibiotic treatment
- Patients switched to linezolid monitored weekly at clinic appointment
- Routine follow up by teams

⇒ Only 1 patient readmitted within 28 days for unrelated reason

Antibiotic Early Discharge Service Evaluation
Hypothesis and Methods

- Significant numbers of patients who remain in hospital solely for antibiotic treatment

- Develop Audit tool to assess patients on Abx and whether they could be discharged from hospital safely on antibiotics (IV or oral)

- 6 hospitals collecting data on Abx use and discharge from hospital (Winchester, Sheffield, St Thomas’s, Leeds, Glasgow, Imperial)

- All patients on Abx on a given day, assessment of continuing requirement for Abx and whether the infection can be managed in the community.

- Data collected by a team of antibiotic pharmacist, physician, nurse

Dryden et al., JAC, 2012; doi: 10.1093/jac/dks193
Antibiotic Management and Early Discharge

Patient + Antibiotic

Continue?
Need for IV route?
Switch IV to Oral?
Does the patient need to be in hospital?
Reasons preventing Discharge?
Suitable for OPAT (IV or oral)?

Stop?
Discharge?

Compare potential Discharge Date with Actual Discharge Date - bed days saved

Collect Data, multiple sites across UK - Clinical and health economic outcomes

Develop Standards of Care for early discharge in infection and care in the community

Dryden et al., JAC, 2012; doi: 10.1093/jac/dks193
Results

• 1356 patients reviewed in acute medical and surgical wards in 6 Hospitals;
• 429 (32%) were on antibiotics

• 165/429 (38%) on IV; 264/429 (62%) on oral

Stop  99 (23%) could stop antibiotic immediately, 26 patients on IV

Continue  330 (77%) patients needed to continue antibiotics

Switch
• 139 patients remaining on IV Abx, 47 (34%) could be switched to oral

Discharge
• 89/429 (20%) patients were recommended for discharge

OPAT
• 10 required IV OPAT; 55 required oral OPAT; 24 had antibiotics stopped

Dryden et al., JAC, 2012; doi: 10.1093/jac/dks193
Distribution of antibiotics prescribed:

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Route</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>Oral</td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>34</td>
<td>65</td>
<td>99</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>9</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td>20</td>
<td>34</td>
<td>54</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>54</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>21</td>
<td>22</td>
<td>43</td>
</tr>
<tr>
<td>Doxycycline</td>
<td></td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Trimethoprim</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>2</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>16</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td>16</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Meropenem</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>2</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Cefalexin</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Linezolid</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Dryden et al., JAC, 2012; doi: 10.1093/jac/dks193
Discharge recommendation and site of infection

- Resp
- SSTI
- UTI
- IAI
- Bone
- Endocarditis
- CNS

No
Yes
Barriers to early discharge

Reason(s) preventing discharge:

- Co-morbidity: 18%
- Requires rehab: 10%
- Requires social input: 13%
- Requires surgical / medical input: 50%
- Team choice: 1%
- Awaiting nursing home: 1%
- Other reason: 7%
- Requires social input: 13%

Dryden et al., JAC, 2012; doi: 10.1093/jac/dks193
Patients: 291 total on ABx; 161 (55%) on oral. 130 (45%) on IV
82/ 291 (28%) could be discharged
Saving on in-patient days of £186,731
Saving on adjusted antibiotic regimens of £1,689
Cost for AMT and medical review – £2468
Cost of Community support - £6227
Cost of OPAT £10,728
NET saving of £170,198 or £2076 (95% c.i. £1196, £2955) per patient
Conclusion

- An effective way of identifying patients who could be managed at home on IV or oral antibiotics

- Significant financial and clinical benefits
  - Improved antibiotic management
  - Improved clinical care
  - Reduce unnecessary bed occupancy and ease pressure on beds
  - Reduce length of stay
  - Prevent HCAI
  - Reduces socio-economic burden of HCAIs
  - Reduction in costs – antibiotics, IVs, bed days saved
  - Improved ward efficiency and productivity
Recommendations

- All hospitals use a systematic review of antibiotics and infection management to identify patients for early discharge

- Improve resourcing of Infection teams

- Develop standards of care for early discharge

- Put into practice
Summary
Facilitating oral switch and early discharge

• Antibiotic review daily
  – Clear guidance
  – By team, requires education
  – By Antibiotic team, requires resources

• Clear documented treatment plan

• Home care or OPAT clinic review.
The End