A&E design evaluation

EVALUATION OF TWO PROPOSED ACCIDENT AND EMERGENCY DEPARTMENTS: BRENT EMERGENCY CARE AND DIAGNOSTIC CENTRE AT CENTRAL MIDDLESEX HOSPITAL, AND AN EXEMPLAR PLAN
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AND AN EXEMPLAR PLAN

London: The Stationery Office
This report evaluates the design of two proposed A&E departments: Brent Emergency Care and Diagnostic Centre (BECaD), and an Exemplar Plan developed as a guide for trusts undertaking new build schemes. It is based on research carried out by Intelligent Space Partnership.

The Exemplar Plan and the A&E services within BECaD were evaluated using key performance indices gathered from assessments of existing A&E departments. The locations assessed are as follows:

- circulation areas;
- arrival and entrances;
- reception and waiting;
- triage and assessment;
- treatment rooms.

Comparison with observed use patterns in two of the existing A&E departments – Hull Royal Infirmary and Kettering – provided information on the occupancy and capacity issues both BECaD and the Exemplar Plan may experience.

Both departments perform well when assessed, though there are some issues with capacity in the Exemplar Plan. Key points are outlined below.

**THE EXEMPLAR PLAN**

Circulation areas support movement to key facilities along two clear routes. Access control prevents unauthorised movement into sensitive areas.

The entrances are placed to support good wayfinding to both reception and resuscitation. The main entrance has excellent natural wayfinding to the front desk. Wayfinding to treatment rooms is good.

Surveillance of waiting areas is supported by the layout.

The capacity and flexibility of assessment and treatment rooms in the plan may not be sufficient to accommodate future demand or changes in use.

The treatment rooms all support patient privacy and dignity, and they also have good staff surveillance.

**BECaD**

Wayfinding in the layout is excellent. The reception area is well positioned by the main entrance, to support wayfinding for new arrivals and visitors. Temporary changes to the use of the department entrances would be supported, though they would not provide the high level of movement support that the intended layout does.

Two waiting areas are poorly surveyed, which could increase the risk of crime in these locations. The waiting area provision for BECaD is lower than in other departments studied.

Both the assessment and treatment rooms in the plan have excellent capacity levels for current use and any future increase in use. Privacy and dignity are supported by the levels of surveillance from circulation areas.

There is a strong separation between the MAC and UTC, which provides good support for their distinct functions. However, staff or patients who need to travel between the departments (for example non-clinical staff) will be forced to travel a long and complex route past the reception and main waiting area. A direct link between the two areas would help to support journeys between the MAC and UTC.
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APPENDIX 1: VISIBILITY MODELLING

REFERENCES
1 Introduction

CONTEXT

1.1 Designing an accident and emergency (A&E) department is a challenging task. A good design must address the problems experienced by many A&E departments around the country:

- long waits for patients;
- violence towards staff;
- criminal behaviour and damage to property;
- lack of privacy and dignity for patients; and
- difficulty for patients and their companions in finding their way around the department.

1.2 A well-designed facility can help to enhance and support patient care, yet it has often been the case that good care is provided despite the weaknesses in the design of the facility.

1.3 The method by which care is being delivered in A&E departments is undergoing change. There is a new service model, which covers both the built environment and the delivery of clinical and non-clinical services. This is based on the “see and treat” system, designed to reduce waiting times and improve the patient experience in A&E departments (for full details refer to ‘See and Treat’, NHS Modernisation Agency).

PURPOSE OF THIS REPORT

1.4 This report evaluates the design of two proposed A&E departments: Brent Emergency Care and Diagnostic Centre (BECaD), and an Exemplar Plan developed as a guide for trusts undertaking new build schemes.

1.5 The report is based on research carried out by Intelligent Space Partnership, and follows on from their earlier research project, the findings of which were published by NHS Estates in ‘The impact of the built environment on care within A&E departments’.

1.6 The first research project was commissioned to review eight existing A&E departments, to compare use patterns and identify design features that support existing working practices as well as the ability of departments to adapt to change. The project was developed around four key actions:

- to support guidance for the building of future departments;
- to provide measures to evaluate planned A&E departments;
- to identify some potential problems prior to construction of new A&E departments; and
- to identify methods for the post occupancy evaluation of departments.

1.7 The measures to evaluate planned A&E departments that were outlined in that report have been used to assess BECaD and the Exemplar Plan to identify the extent to which these plans are likely to support the delivery of care.

1.8 As an additional comparator, the observed use patterns for two of the eight A&E departments have been applied both to the Exemplar Plan and to BECaD facilities to identify how these plans would cope with the usage levels observed at departments of a similar size. These two departments were chosen as they cater for a similar number of patients per annum, and one of these has implemented the new clinical model providing “see and treat”.

THE EXEMPLAR PLAN

1.9 The Exemplar Plan was designed by AHA architects. It was developed to look at the clustering of assessment and treatment rooms and associated support facilities described in HBN 22 ‘Accident and emergency facilities for adults and children’. It has been designed to support 50,000 patients per annum.

BECaD

1.10 The BECaD facility will provide services including acute medicine, surgery, gynaecology, trauma, orthopaedics and inpatient paediatrics, but not consultant-led obstetrics. It has been designed by HLM and Avanti Architects on behalf of Central Middlesex Hospital NHS Trust.
Space Use
- Assessment
- Circulation
- Main Entrance
- Maintenance
- Sanitary
- Staff
- Storage
- Treatment
- Waiting

Figure 1  Proposed layout of the Exemplar Plan

Figure 2  The A&E Department of the BECaD Plan
In BECaD, the A&E department is divided into two services. The minor work that constitutes just over two thirds of current activity will be treated in an urgent treatment centre (UTC). This centre will also accommodate GP out-of-hours and unscheduled work. The major A&E work will be treated in a major assessment centre (MAC).

**EVALUATION OF THE EXEMPLAR PLAN AND BECaD**

The Exemplar Plan and the A&E services within BECaD were evaluated using key performance indices gathered from assessments of existing A&E departments. The locations assessed are as follows:

- circulation areas;
- arrival and entrances;
- reception and waiting;
- triage and assessment;
- treatment rooms.

The findings for each area are given in the following chapters.
2 Circulation

WAYFINDING

2.1 It is important that the natural wayfinding of staff, patients and visitors is supported to ensure that people find their way to locations such as the reception and waiting areas, but also that they do not inadvertently access sensitive areas of the department such as paediatrics or resuscitation.

2.2 The designs aim to limit:

- the number of changes in direction needed to access the reception from the main entrance;
- the distance between the treatment rooms and the main entrance;
- the number of treatment rooms that visitors and patients will pass when travelling between these areas.

2.3 To benchmark the likely routes throughout the plans, software analysis methods were used to identify the structure of the building and how this supported wayfinding. This involved identifying highly visible locations which are likely to be heavily used and highlighting locations that are more hidden from view which people are less likely to use. The support of natural wayfinding compliments procedures for the control of access between areas within the department and to the main hospital.

Figure 4 Visibility analysis of the Exemplar Plan
2.4 The level of visibility is shown in a spectral colour range with the most visible locations in red to the most secluded in blue.

**Wayfinding in the Exemplar Plan**

2.5 As can be seen in Figure 4, the most accessible location in the plan is the central staff base (A). There are also two highly visible corridors which would be clear, direct routes for people to take, these are: the route from the ambulance entrance to the main hospital (B); and the route along the back of the treatment rooms (C).

2.6 The Exemplar Plan supports patient journeys in that:

- patients have direct (but controlled) access from the waiting areas to assessment rooms, and from the main entrance to reception areas;
- there is direct access from the assessment rooms to the treatment rooms and from both the assessment and treatment rooms to resuscitation without going through a public space;
- from alternative entrances, there is a maximum of two changes in direction to the reception area.

2.7 For visitors:

- visitors can access directly the reception from the main entrance. There is controlled access to the treatment rooms, but visitors leaving the treatment rooms can do so freely and directly through the reception area.

**Wayfinding in BECaD**

2.8 A visibility analysis has been carried out for circulation routes, as shown in Figure 5. This shows the plan strongly supports wayfinding along the key movement route from the front entrance to the Hospital Street. The Hospital Street itself has excellent visibility along its length which will support good wayfinding.

2.9 The visibility analysis of circulation space within the department shows that there is a very good hierarchy of routes:

- the primary circulation routes have highest visibility, which supports their role as key movement routes;
- secondary routes within the department have good visibility, at a lower level than the primary routes;
- other areas are more secluded, with treatment areas within the MAC and resuscitation having lowest visibility.

2.10 The visibility analysis in Figure 6 shows wayfinding for all space within the department. Treatment rooms and observation areas have low visibility which will contribute towards patient privacy and dignity.
2.11 The most visible location is the staff base at the centre of the MAC, which is supportive of good observation from and of the bays. This is discussed further in ‘Surveillance of treatment rooms’, paragraph 6.7.

Figure 6 Visibility analysis of all spaces in BECaD
3 Arrival and entrances

ACCESS CONTROL

3.1 It is important to control the movement of patients and visitors within A&E departments to ensure that they do not access sensitive areas.

3.2 Circulation can be directed by the building layout through wayfinding, assisted where necessary by physical control measures such as locks.

Access control in the Exemplar Plan

3.3 The Exemplar Plan shows two linked ambulance entrances, both of which have access control measures in place to restrict unauthorised access by other patients, staff and visitors. This greatly reduces the number of entrants through this route and along the corridor which leads to sensitive areas such as resuscitation.

3.4 The access control measures in the Exemplar Plan are shown in Figure 7.

Access control in BECaD

3.5 Information about access control inside the department was not supplied. However, as noted in ‘Wayfinding in BECaD’, paragraph 2.8, the natural wayfinding of the layout will help to reduce accidental access to sensitive areas.

FLEXIBILITY OF ENTRANCES

3.6 It is important that the design caters for the swift transfer of patients entering through the main entrance to resuscitation, and from the ambulance entrance to the reception.

Flexibility of entrances in the Exemplar Plan

3.7 As seen in Figure 8, from either ambulance entrance the wayfinding to the reception desk is supported, with either direct access or only one change of direction required. Additionally, there is direct access to resuscitation from both ambulance entrances.

Figure 7 Access control in the Exemplar Plan
Figure 8  Access from the ambulance entrance in the Exemplar Plan

Figure 9  Access from the main entrance in the Exemplar Plan

Figure 10  Visible area from the main entrance in BECaD
3.8 It is also important that if a severely ill patient enters via the main entrance, they can access resuscitation easily. As seen in Figure 9, the wayfinding to resuscitation is supported in the plan enabling patients to access resuscitation if required, but with access control limiting use.

**Flexibility of entrances in BECaD**

3.9 The main entrance of BECaD prevents accidental access into the treatment areas, as shown in Figure 10. There is no visual connection between the main entrance area, including the reception and lobby, and the treatment rooms. The journey required to reach the treatment areas is four times longer than the direct path to the reception desk.

3.10 In addition to the direct path from the main entrance to the reception desk, the natural wayfinding of the department also supports movement from the main entrance towards the Hospital Street (see ‘Wayfinding to reception in BECaD’, paragraph 4.4).

3.11 The ambulance entrance provides excellent access to the treatment areas. Figure 11 shows a clear line of sight from the entrance to the resuscitation area and the MAC, which supports easy movement to these areas. The journey distance is also extremely short, as shown in Figure 12 overleaf.

3.12 The privacy and dignity of patients moving from the ambulance entrance to the treatment areas is well supported by the location of the ambulance entrance:

- there is separation between the two entrances. Waiting and circulation areas for visitors and non-urgent patients do not have a direct line of sight into the transfer area around the ambulance entrance;
- the short distance between the ambulance entrance and the entry points into treatment areas means that the exposure of patients to people passing along the corridor is limited.

3.13 In the event of closure of the ambulance entrance, all external access to the department could take place via the main entrance.

3.14 In the event of closure of the main entrance, all external access to the department could take place via the ambulance entrance.

3.15 Wayfinding to the reception area for visitors and non-urgent patients is supported for access via the ambulance entrance, but could be improved through:

- extra signage to direct people away from the entrances to the MAC and resuscitation areas; and
- additional access control on internal doorways to prevent accidental access to sensitive areas.

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**Figure 11** Visible area from the ambulance entrance in BECaD
Figure 12  Routes from both entrances in BECaD
4 Reception and waiting areas

WAYFINDING TO RECEPTION

4.1 It is important that the reception is directly visible from the main entrance. This will help ensure that people go directly to the reception staff on arrival rather than accessing other areas looking for help.

4.2 It is also important to support a clear route between the ambulance entrance and the reception. This is both in case of patients using the wrong entrance, and for visitors and family members who may be entering the hospital accompanying a severely ill patient.

Wayfinding to reception in the Exemplar Plan

4.3 As can be seen in Figure 13, there is direct access from the main entrance to reception. Wayfinding from the ambulance entrance to the reception is also supported in the layout.

Wayfinding to reception in BECaD

4.4 As shown in Figure 14, there is a clear line of sight from the main entrance to the reception desk. This will support wayfinding for people entering the department.

4.5 Wayfinding from the ambulance entrance to the reception is discussed in paragraph 3.15.

WAITING AREA PROVISION

4.6 It is important that the reception and waiting area have sufficient space for the needs of patients and visitors using the A&E department.

Waiting area provision in the Exemplar Plan

4.7 The size of waiting areas in the Exemplar Plan and BECaD are shown in Table 1 overleaf.

4.8 The waiting area in the Exemplar Plan currently accounts for just under 6.5% of the total department.

![Figure 13 Wayfinding to Reception in the Exemplar Plan](image-url)
area. The waiting area is used by visitors and family members as well as by patients. To ensure that sufficient space is built into this area, the maximum ratio of patients to visitors was found to be 1.5 visitors for every patient (see ‘The impact of the built environment on care within A&E departments’). Therefore, if the size of the waiting area is based on 50,000 patients per annum, it should be designed to cope with a further 75,000 visitors per annum, totalling 125,000 people using the department.

4.9 Proposed changes to the clinical care pathways are likely to result in shorter waiting times for patients resulting in less time spent in the A&E department as a whole. This is likely to result in a lower usage of the waiting areas. However, visitors often wait for patients in the A&E waiting areas while they are being treated, and these people will still need to be accounted for in future A&E departments.

4.10 For comparison with the Exemplar Plan and BECaD, Figure 15 shows the peak occupancy of circulation areas in eight departments split by the number of patients, staff and visitors. Figure 16 shows the same measure for the waiting areas.

Waiting area provision in BECaD

4.11 As shown in Table 1, the waiting area in BECaD is smaller than in other A&E departments studied (see ‘The impact of the built environment on care within A&E departments’) and in the Exemplar Plan. A comparison between the size of waiting areas in BECaD and another A&E department is shown in Figure 17.

SURVEILLANCE OF WAITING AREAS

4.12 It is important that people in the waiting area can be overseen by staff members, be they reception,

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**TABLE 1 WAITING AREA PROVISION IN BECAD**

<table>
<thead>
<tr>
<th>DEPARTMENT</th>
<th>WAITING AREA</th>
<th>MAXIMUM OCCUPANCY OF CIRCULATION AREA</th>
<th>MAXIMUM OCCUPANCY OF WAITING AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average size</td>
<td>9%</td>
<td>37</td>
<td>54</td>
</tr>
<tr>
<td>Exemplar Plan</td>
<td>6.5%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>BECaD</td>
<td>4%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Kettering</td>
<td>6%</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td>Hull Royal Infirmary</td>
<td>9%</td>
<td>58</td>
<td>40</td>
</tr>
</tbody>
</table>

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**Figure 14** Wayfinding to Reception from main entrances in BECaD
Figure 15  Peak occupancy of circulation areas in eight A&E departments

Figure 16  Peak occupancy of waiting areas in eight A&E departments
security or clinical staff. This is to help ensure that if a patient does become unwell, someone will be around to inform clinical staff. Additionally, with the reception being overseen, it is less likely that crime will be committed, especially damage to the furniture or fittings. If an incident does occur then it will be picked up speedily for the security staff to deal with.

**Surveillance of waiting areas in the Exemplar Plan**

4.13 In the Exemplar Plan, the combination of the access control measures and the high level of surveillance of the waiting area supports controlled access into the treatment areas by members of the public, as shown in Figure 18. It is also likely to reduce the risk of some crimes occurring in the waiting area.

**Surveillance of waiting areas in BECaD**

4.14 The main waiting areas in the UTC and Imaging are overseen by reception staff. Both the waiting areas in the MAC are only surveyed by passing clinical staff.

- The waiting areas adjacent to the reception desk (A) both have excellent surveillance and are in close proximity to the reception area. This surveillance will be by both clinical and non-clinical staff.
- The waiting area between the two courtyards (B) is surveyed from inside the MTC. However, this surveillance is by clinical staff who are some distance from the waiting area, so the effectiveness of casual surveillance is lower.

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**Figure 17** Size of waiting area comparison for BECaD

**Figure 18** Surveillance of waiting areas in the Exemplar Plan
- The central waiting area (C) has no surveillance from staff bases, though some overlooking will be provided by people passing along the corridor.

4.15 To mitigate the effect of low surveillance, some waiting areas could be monitored via CCTV cameras linked to the main reception desk.

4.16 The entry corridors from the reception area into the UTC and MAC are well surveyed by the reception desk.
5 Triage and assessment

Wayfinding to assessment rooms

5.1 For the new service model it is important that the assessment rooms are directly visible and accessible from the main waiting area. As the majority of patients will currently be discharged directly from assessment rooms, it is important to ensure the privacy and dignity of other patients by preventing them accessing other areas of the department. To ensure this, assessment rooms should be located off the waiting area with controlled access through to the main treatment areas.

Wayfinding to assessment rooms in the Exemplar Plan

5.2 As all the assessment rooms lead directly from the waiting area they are directly accessible by patients and visitors. With a second door leading to the staff base and the treatment rooms, this supports patients’ access to treatment rooms if required, and enables staff to access the staff base easily.

Wayfinding to assessment rooms in BECaD

5.3 There is no triage at BECaD. Instead, a “conductor” will assess and guide patients to either the UTC or MAC. With a separate UTC and MAC, and full door closures, the layout provides good wayfinding and patient privacy and dignity.

Privacy and dignity

Privacy and dignity in the Exemplar Plan assessment rooms

5.4 The Exemplar Plan has fully addressed the privacy and dignity of patients in the assessment rooms. These rooms have full door closures on both sides which will provide audio and visual privacy for patients. Because patients’ details are taken within this room rather than at reception, this will further enhance the privacy for patients in discussing their conditions.

Privacy and dignity in BECaD assessment rooms

5.5 Each of the assessment rooms in the UTC has full audio and visual privacy.
6 Treatment rooms

PROVISION AND FLEXIBILITY OF USE OF TREATMENT ROOMS

6.1 The number of assessment and treatment rooms required will be based upon:

- the number of patients attending A&E;
- the illnesses or conditions that patients present with;
- the number and roles of clinical staff.

6.2 It is likely that a greater proportion of patients attending A&E in the future will require treatment. Minor Injuries Units and other services are likely to divert a high proportion of the more minor patients away from the A&E departments.

6.3 To ensure that the departments can cope with the current demand by minor injuries patients and to ensure that there is not under utilisation of valuable space within A&E in future, provision must be made in the design to change the use of these assessment rooms if there is no longer a requirement for them.

6.4 For a plan to support flexibility of room usage it must ensure that:

- staff can survey both the treatment and assessment rooms based in one single location; and
- both types of room are large enough to be designated as either treatment rooms or assessment rooms.

Provision and flexibility of use of treatment rooms in the Exemplar Plan

6.5 In the Exemplar Plan, the assessment and treatment rooms have the same dimensions, which means that if required, an assessment room could be converted into a treatment room in the future. Additionally, as all the rooms are centred around the staff base, the door closure could potentially be changed to achieve surveillance from the staff base. Additionally, a treatment room can be used flexibly as an assessment room without adaptation.

Provision and flexibility of use of treatment rooms in BECaD

6.6 The layout of the department has a clear separation between the UTC and MAC areas, which could reduce the possibility of future flexibility if the ratio between patients presenting with minor and serious injuries changes.

SURVEILLANCE OF TREATMENT ROOMS

6.7 It is important to ensure that there will be observation of all patients treated in the A&E departments. Patients may be observed:

- remotely through use of technology;
- by having a staff member based in the same room as the patient; or
- from a staff base that enables views of treatment rooms.

Surveillance of treatment rooms in the Exemplar Plan

6.8 The majority of the treatment rooms can be surveyed from the central staff base, as shown in Figure 20. Two rooms (A) in the corners have restricted views. Where assessment rooms are directly observable from the staff base, rooms can be converted to treatment rooms while maintaining visual access by staff. The placement of door openings in several rooms (B) does not facilitate the optimum level of natural surveillance.

Surveillance of treatment rooms in BECaD

6.9 The treatment rooms within the MAC have excellent surveillance from the staff base, as shown in Figures 21 and 22.

6.10 The layout of the UTC makes surveillance from a single location difficult. However, most rooms within the UTC are unlikely to contain a patient unless they are undergoing examination or treatment with a member of clinical staff.
Figure 20  Surveillance of treatment rooms in the Exemplar Plan

Figure 21  Surveillance of treatment rooms from MAC staff base 1 in BCaD
WAYFINDING TO TREATMENT ROOMS

Wayfinding to treatment rooms in the Exemplar Plan

6.11 For patients who are transferred from the assessment rooms, there is direct access into the treatment area without having to travel through any public spaces. Privacy for patients is also maintained during transfer from resuscitation to the treatment areas as the route does not go through any corridors or public areas. For other patients, there is a controlled door which leads directly from the waiting area to the treatment area, again minimising both journey distances and supporting wayfinding.

Wayfinding to treatment rooms in BECaD

6.12 For patients:

- optimal wayfinding to the resuscitation and major treatment areas is supported, as shown in Figure 23. These rooms are located close to the emergency entrance, with only one change in direction necessary;
- there is access from the main entrance to the MAC and UTC treatment areas, which is moderated by the location of the reception desk;
- there is also direct access from treatment and associated waiting rooms to the resuscitation room without going through public spaces.

6.14 For staff members:

- there are direct routes between all treatment rooms in the MAC area and a dedicated staff base. This allows staff to easily visit different patients;
- there is a large separation between the UTC and MAC, with no direct route connecting them. Although this will support patient wayfinding, it increases the distance and complexity of the staff journey required to transfer a patient between the UTC and MAC. Figure 24 shows that travelling to the UTC from the MAC requires the most complex journey through the department, with five or six direction changes required;
- although the journey between the MAC and UTC is less likely to be made regularly by clinical staff, support staff such as porters and cleaners may use this route frequently. To reduce the severance between the UTC and MAC, a corridor could be added to link the two areas directly.
Figure 23 Number of changes of direction required to reach a treatment room in BECaD

Figure 24 Journey complexity between the UTC and MAC in BECaD
PRIVACY AND DIGNITY

Privacy and dignity in treatment rooms in the Exemplar Plan

6.15 The privacy and dignity of patients in the treatment rooms is achieved in the Exemplar Plan since the main access corridor leads to the back of the rooms and there is no direct route through the staff base except through the controlled access for family members or friends visiting the patients. If the door closures enable some views from the staff base, then there is a possibility that other visitors or patients may see into these rooms. However, as the view will be through the staff base, it is likely that these will be partially restricted due to staff members standing in this area or furniture that is sufficiently high to restrict views between patients.

Privacy and dignity in treatment rooms in BECaD

6.16 It is not possible to see into a treatment area from any corridor or waiting area, as shown in Figure 25. In this plan, areas that cannot see a treatment room are shown in white. This provides excellent support to patient privacy and dignity.

![Figure 25 Areas without direct surveillance of treatment rooms in BECaD](image-url)
7.1 In order to better understand how the Exemplar Plan and BECaD layouts are likely to be used in practice, the results from surveys of existing departments of similar size were applied. The tests evaluated each department’s:
- ability to accommodate existing mean and peak levels of attendance;
- ability to cope with future increases in attendance due to growth in demand for A&E services; and
- flexibility of layout to cope with a division between adult and paediatric care.

**ASSESSMENT OF THE PLANS USING PREVIOUS STUDIES**

7.2 To assess the Exemplar Plan and BECaD using the findings from the observation studies, information gathered about the use patterns of the two case-study departments were applied to both plans. This gives an indication of the approximate expected distribution of people within each layout. The rooms evaluated included the treatment and assessment rooms, and the waiting and reception areas.

7.3 The two case studies chosen were selected for the following reasons:
- Hull Royal Infirmary treats a similar number of patients to both BECaD and the Exemplar Plan;
- Kettering has implemented “See and Treat” services, making it similar in use to the planned departments.

7.4 To assess the departments, the following methodology was used:
- All people located in triage were placed in assessment rooms.
- All people located in Major Injuries treatment rooms were located in treatment rooms.
- All people located in Minor Injuries treatment rooms were located in assessment rooms.
- As all the other areas had the same uses and names; the people located in these were directly transferred to the same locations in the Exemplar Plan and BECaD.
- Where there were not enough treatment rooms, the required number of rooms was shown at the bottom of the plan, with the use pattern for each room replicated.
- Only the reception, waiting area, assessment rooms, treatment rooms and staff bases were included in the evaluation.

**Comparative data**

7.5 To help assess the Exemplar Plan and BECaD, comparative data was produced from previous studies of A&E departments.

7.6 The information used to compare the departments is set out in Table 2.

**Introduction to Hull Royal Infirmary**

7.7 Hull Royal Infirmary A&E is located in the ground floor of the hospital. It has two entrances, one for those arriving on foot, the other for those arriving by ambulance. It has a dedicated paediatrics department with treatment rooms, a waiting area and a dedicated paediatric resuscitation room.

<table>
<thead>
<tr>
<th>Table 2: Comparison of Facilities in the Four Departments</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Number of assessment rooms</td>
</tr>
<tr>
<td>Number of treatment rooms</td>
</tr>
<tr>
<td>Peak occupancy in Assessment</td>
</tr>
<tr>
<td>Peak occupancy in Treatment</td>
</tr>
<tr>
<td>Mean occupancy in Assessment</td>
</tr>
<tr>
<td>Mean occupancy in Treatment</td>
</tr>
</tbody>
</table>

¹. Source: BECaD FITN Volume 2: Clinical Model p 30
On the day of the survey, the department’s occupancy increased during the course of the day and peaked at 6pm.

The key findings from this department were that:
  - patients were mainly located in the waiting area or in the treatment cubicles;
  - few patients were seen in circulation spaces or staff areas;
  - the locations of visitors were very similar to those of patients;
  - there was a clustering of staff members in the staff bases in the minor, paediatrics and major treatment areas;
  - a high concentration of staff members was also found in the circulation space and the reception area;
  - there is a very low staff presence in the waiting area.

Introduction to Kettering

The Kettering A&E department is located on the ground floor of the hospital. It has two entrances, one for those arriving on foot, the other for those arriving by ambulance. There are two paediatric rooms, however these are not fully dedicated to children as adult patients were treated in these rooms on the day of the survey.

On the day of the survey, the department’s occupancy increased until it peaked at 2pm. This level was maintained for the rest of the day.

The key findings from this department were that:
  - patients and visitors were mainly located in the waiting area or in the treatment cubicles;
  - few patients were seen in circulation spaces or staff areas;
  - there were more visitors than patients in the waiting area and more patients than visitors in the treatment rooms;
  - there was a clustering of staff members around the centrally-arranged staff base. A high concentration of staff members were also found in the treatment cubicles and resuscitation area;
  - further staff members were located in the circulation space. There was a very low presence of staff in the waiting area.

Observation study methodology

Information about the existing departments was gathered through extensive observation studies, through space use and static snapshot surveys:
  - The space use surveys were used to glean information on levels of occupancy for different parts of the department over the course of a working day, and to identify how its layout supports the working practices of staff, and the movement of patients and visitors.
  - A static snapshot technique was used, where an “observer” walked through the circulation space in the department once every hour and recorded, where visible, the number and category of people in each room. People were categorised according to whether they were staff, patients or visitors, and if staff members, what position they held.

Comparison of Exemplar Plan with Observed Departments

The key findings for the Exemplar Plan are as follows:
  - there is insufficient capacity to accommodate current peak occupancy levels in assessment areas;
  - there is likely to be a problem with capacity if the number of patients attending the department rises;
• splitting the department between adult and paediatric use would exacerbate the capacity problem.

Normal occupancy and capacity

7.15 The Exemplar Plan does not have sufficient capacity to accommodate the levels of occupancy in the assessment areas that were observed at Kettering, as shown in Figure 28. During a 12-hour period, the occupancy of the department was at full capacity or higher than capacity for half of the time.

7.16 Figure 29 shows the peak observed occupancy of Hull and Kettering alongside the maximum planned occupancy of the Exemplar Plan. Although the peak occupancy is much higher than the mean occupancy (see Table 2), any future increases in the number of patients will see this level of occupancy more often, and so the layout must be able to accommodate current peaks at below capacity levels. The chart shows that

• the assessment areas of the Exemplar Plan do not have sufficient capacity to accommodate current levels of peak occupancy as observed at Kettering;
• the treatment areas of the Exemplar Plan have a capacity level that is very similar to the peak occupancy of both observed departments, which indicates that future increases would be hard to accommodate.

7.17 To illustrate the future use of the Exemplar Plan layout, possible occupancy for the treatment and assessment areas has been calculated using data from the Kettering case study. As Figure 30 shows, the limited capacity in the treatment areas could lead to total occupancy for extended periods, which would have an impact on waiting times and quality of patient care.

COMPARISON OF BECaD WITH OBSERVED DEPARTMENTS

7.18 The key findings for BECaD are as follows:

• the capacity in both assessment and treatment areas is very good for current and future levels of occupancy.

Occupancy

7.19 Figure 31 shows the peak observed occupancy of Hull and Kettering alongside the maximum planned capacity of BECaD:

• the assessment areas of BECaD have sufficient capacity to accommodate current levels of peak occupancy and a small future increase;
• the treatment areas of BECaD have very high capacity compared to the peak occupancy levels. This means that they will be able to manage future increases in occupancy comfortably.
Figure 29  Peak occupancy compared to projected capacity: Exemplar Plan

Figure 30  Possible occupancy of treatment and assessment areas of the Exemplar Plan
Figure 31  Peak occupancy compared to projected capacity: BECaD
8.1 The Exemplar Plan and BECaD were assessed using Visibility Graph Analysis techniques (see Appendix 1), and key performance indicators created from previous studies of A&E departments. Comparison with observed use patterns in two departments provided information on the occupancy and capacity issues both departments may experience.

8.2 Both departments perform well when assessed, though there are some issues with capacity in the Exemplar Plan. Key points are outlined below.

THE EXEMPLAR PLAN

8.3 Circulation areas support movement to key facilities along two clear routes. Access control prevents unauthorised movement into sensitive areas.

8.4 The entrances are placed to support good wayfinding both to reception and resuscitation. The main entrance has excellent natural wayfinding to the front desk. Wayfinding to treatment rooms is good.

8.5 Surveillance of waiting areas is supported by the layout.

8.6 The capacity and flexibility of assessment and treatment rooms in the plan may not be sufficient to accommodate future demand or changes in use.

8.7 The treatment rooms all support patient privacy and dignity, and they also have good staff surveillance.

BE CaD

8.8 Wayfinding in the layout is excellent. The reception area is well positioned by the main entrance, to support wayfinding for new arrivals and visitors. Temporary changes to the use of the department entrances would be supported, though they would not provide the high level of movement support that the intended layout does.

8.9 Two waiting areas are poorly surveyed, which could increase the risk of crime in these locations. The waiting area provision for BECaD is lower than in other departments studied.

8.10 Both the assessment and treatment rooms in the plan have excellent capacity levels for current use and any future increase in use. Privacy and dignity are supported by the levels of surveillance from circulation areas.

8.11 There is a strong separation between the MAC and UTC, which provides good support for their distinct functions. However, staff or patients who need to travel between the departments (eg non-clinical staff) will be forced to travel a long and complex route past the reception and main waiting area. A direct link between the two areas would help to support journeys between the MAC and UTC.
Visibility analysis is a measure of how much space pedestrians can see as they move around at ground level. In dense urban areas, where there are many possible origins and destinations for pedestrians, there are a huge number of small pedestrian journeys between different locations. However, pedestrians are highly sensitive to the complexity of routes and they tend to choose the simplest path. This means that overall, movement flows tend to become concentrated on those streets that offer the simplest visual links through the street grid.

Visibility (the area of usable space visible to a pedestrian at any point in the street grid) is one of the most important factors determining the pattern of pedestrian flows in models of movement. Research in many different cities over the last 20 years has shown that pedestrian movement flows tend to be greater on routes that provide clear and direct visual links through the built environment (so-called ‘desire lines’) than on complex routes where people cannot see directly where they want to go (A summary of this research can be found in ‘Space is the Machine’, Cambridge University Press). Pedestrians rely heavily on visual information to orient themselves and move about, so their movement is highly influenced by this.

**METHODOLOGY OF VISIBILITY ANALYSIS**

Intelligent Space has developed state-of-the-art software to quantify visibility for pedestrians in street networks. The software uses a technique known as “Visibility Graph Analysis”. The analysis calculates the visual field for a pedestrian at any point in the public space network. Figure 32 below provides an example of a visual field: it shows everything that a pedestrian can see at ground level from a particular point in Shoreditch, central London.

Taking accurate scale maps of an area, a computer algorithm creates a grid of sample observation points throughout the pedestrian movement space. The computer then calculates the visual field at 360 degrees from each point in the grid by checking which of the other points each point can see. In Figure 33, the points in red are all those directly visible from the location shown in Figure 32.
The analysis tells us the area in square metres that is visible from a pedestrian standing at this point. By performing the same calculation for all points in a grid, measures of the average visibility of an area are calculated to enable comparisons between alternative designs. The resulting pattern of visibility can be represented by colouring each point according to the area of its visual field. An example of this is shown in Figure 34, where the visibility of each part of public space is represented in an equal range, spectral colour scale from red (highest visibility) to blue (lowest visibility).
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