Cost-effectiveness of Quantitative Ultrasound as a technique for screening and diagnosing osteoporosis and subsequently for the prevention of osteoporotic fractures

P. Aidelsburger (1), F. Hessel (1), J. Wasem (1)
(1) Alfred Krupp von Bohlen and Halbach Foundation, University of Duisburg-Essen, Essen, Germany

Objectives
• Osteoporosis mainly concerns postmenopausal women
• Osteoporosis increases the risk of (low trauma) fractures
• Main fracture localisations are distal forearm, spine and femoral neck
• Osteoporosis can be treated by calcium, hormone replacement therapy and therapy with bisphosphonates
• Diagnosis of osteoporosis covers clinical parameters and the measurement of bone density
• Gold standard for the measurement of bone density is the dual X-ray absorptiometry (DXA)
• Qualitative ultrasound (QUS) as a non-invasive and radiation-free technology is becoming more important in the diagnosis of osteoporosis

On behalf of the German Agency for Health Technology Assessment (DAHTA@DIMDI) a rapid health economic assessment (HTA) was conducted to examine the cost-effectiveness of QUS as a technique for screening and diagnosing osteoporosis and subsequently for the prevention of osteoporotic fractures

Methods
The rapid health economic HTA was conducted according to the German methodological recommendations for rapid health economic HTA developed by the authors (1). Following steps have been conducted:

1. Systematic literature search in the medical and economical literature databases Medline, Embase and Econlit, the HTA databases DARE (Database of Abstracts of Reviews of Effectiveness), NHS (Economic Evaluation Database), HTA (Health Technology Database) as well as the Cochrane library. No limitations to publication language and publication data was done.
2. Qualitative and quantitative information synthesis out of the identified literature
3. Calculation of the incremental cost-effectiveness of different proceeding possibilities by the authors of the HTA using economic data obtained out of the literature. Following proceedings have been considered:

Two-step proceeding: QUS for all women as a first step, in case of a positive QUS a DXA is performed as a second step
One-step proceeding: Comparing QUS with DXA

Results
Four publications (2-5) dealt with the question of the cost-effectiveness of QUS as a screening instrument in a two-step proceeding. Study population in all studies have been postmenopausal women of different age groups. Age groups and quantitative parameters are shown in table 1. All publications showed methodological weaknesses, especially in the consideration of relevant economic parameters. Nevertheless cost data of three studies (3-5) could be used for own calculations of incremental cost-effectiveness ratios.

An additional case diagnosed by DXA in a one-step proceeding rises costs of 1,000 Euro.

Table 1: Age groups and quantitative parameters of the four identified studies

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<tr>
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</thead>
<tbody>
<tr>
<td>Cost/DXA examination</td>
<td>EUR 71</td>
<td>EUR 68</td>
<td>EUR 68</td>
<td>not stated</td>
</tr>
<tr>
<td>Cost/QUS examination</td>
<td>EUR 8</td>
<td>EUR 7</td>
<td>EUR 23</td>
<td>not stated</td>
</tr>
<tr>
<td>Sensitivity of QUS</td>
<td>75%</td>
<td>73%</td>
<td>93%</td>
<td>90%</td>
</tr>
<tr>
<td>Specificity of QUS</td>
<td>81%</td>
<td>73%</td>
<td>84%</td>
<td>64%</td>
</tr>
<tr>
<td>Positive predictive value of QUS</td>
<td>56%</td>
<td>19%</td>
<td>89%</td>
<td>52%</td>
</tr>
<tr>
<td>Negative predictive value of QUS</td>
<td>90%</td>
<td>97%</td>
<td>89%</td>
<td>94%</td>
</tr>
</tbody>
</table>

Table 2 demonstrates the calculation of a monetary cut-off point in a two-step proceeding. A two-step proceeding with QUS is cost-effective as long as the costs of one QUS examination are lower than 31%-51% of the costs of one DXA examination (51% reported by Lippuner et al.)

Table 2: Calculation of a monetary cut-off point in a two-step proceeding

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>EUR 169</td>
<td>EUR 491</td>
<td>EUR 118</td>
<td></td>
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<tr>
<td>EUR 292</td>
<td>EUR 867</td>
<td>EUR 116</td>
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<td>EUR 623</td>
<td>EUR 1,884</td>
<td>EUR 91</td>
<td></td>
</tr>
<tr>
<td>EUR 30</td>
<td>EUR 29</td>
<td>EUR 21</td>
<td></td>
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</tbody>
</table>

Conclusion
A prioritisation of a two-step or a one-step proceeding is not possible at present due to missing data and the lack of evidence.

Decision analytic models considering long-term effects are recommended.

References
First experiences with the conduction of rapid health economic Health Technology Assessments

P. Aidelsburger (1), F. Hessel (1), S. Felder (2), J. Wasem (1)
(1) Alfried Krupp von Bohlen and Halbach Foundation, University of Duisburg-Essen, Essen, Germany (2) Faculties of Medicine and Economics, University Clinic, ISMHE, Magdeburg, Germany

Objectives
- The German Agency for Health Technology Assessment at the German Institute for Medical Documentation and Information (DAHTA@DIMDI) commissions research projects for Health Technology Assessment (HTA)
- Existing German guidelines for the conduction of HTA assure comprehensive HTAs of high quality
- The conduction of comprehensive HTAs is time consuming and the HTA might miss to give answers to a well-defined (health-economic) question in a reasonable time period
- The authors were engaged by the DAHTA@DIMDI to develop methodological guidelines for the conduction of rapid health economic HTAs
- The guidelines should enable authors to conduct a rapid health economic HTA within three month (six month including reviewing process), without loss of quality
- At the same time the authors were engaged to conduct a rapid health economic HTA to assess the cost-effectiveness of Quantitative Ultrasound (QUS) as a technique for screening and diagnosing osteoporosis
- The rapid health economic HTA was conducted by following the previous developed methodological recommendations
- This poster reports critically our experiences with the conduction of a rapid health economic HTA following the developed methodological recommendations.

Our research question is, if the developed methodological recommendation provide an appropriate instrument for the conduction of rapid health economic HTA

Methods
Development of methodological recommendations
1. A systematic literature search was conducted to identify methodological guidelines for the conduction of rapid (health-economic) HTA
Used databases: Medline, Embase, Econlit, Biosis Previews, HSPROJ, HSTAT, HTA-Databases (HTA, NEED, DARE), Internet presentations of international HTA-organisations, INAHTA HTA-database and Cochrane Library
2. Elaboration of the main differences between comprehensive and rapid HTAs
3. Methodological recommendations for rapid health economic HTA were given to the following structural elements: study question, background information, perspective, decision analysis, searching and evaluation of information, discussion, conclusion, quality assurance, dissemination

Assessment of the cost-effectiveness of QUS
Following the methodological recommendations the cost-effectiveness of QUS as a technique for screening and diagnosing osteoporosis was assessed.

Careful consideration of advantages and disadvantages of the used methodological recommendations
While doing the rapid health economic HTA and after the reviewing process problems and weak points of the methodological recommendations have been recorded.

Results
The methodological guidelines turned out to be a proper instrument for the conduction of rapid health economic HTA, as long as several crucial points are considered carefully:
1. The study question should be formulated precisely and should define the given technology, alternative technology (as few as possible), outcome and study population. We restricted the original study question commissioned by DAHTA@DIMDI regarding to the study population, number of compared technologies and clinical outcome parameters. All restrictions should be made in agreement with the ordering party to assure that the question of interest still can be answered.
2. Background information should be short and give the required information that are needed. Data concerning effectiveness of a technology (respecting different possible application forms) is one important information to judge the cost-effectiveness of a technology. As it is not possible in a rapid health economic HTA to provide this information it should be considered carefully if a comprehensive HTA concerning the effectiveness of the assessed technology is necessary.
3. Methodological recommendations clearly support the conduction of decision analytic modeling (decision tree or Markov models). In the case of QUS a decision analytic model was developed to demonstrate the different application possibilities of QUS as a technique for screening and diagnosing osteoporosis. Due to missing data concerning the short and long term effects of QUS examinations we were not able to calculate the cost-effectiveness of QUS using the developed model.

Conclusion
A rapid health economic HTA is the assessment of a technology under economic aspects with a targeted question. Therefore rapid health economic HTAs are indicated for restricted questions with high priority by decision makers.
The conduction of a rapid health economic HTA demands careful considerations. In cooperation with the potential addressee the study question should be focussed. In some cases, especially in the case a decision analysis is demanded rapid health economic HTA will not be the appropriate instrument for its own, but should be used in combination with comprehensive HTA.
Further research is needed. More rapid health economic HTAs should be conducted following the methodological recommendations accompanied by a systematic quality assessment. Further experiences might result in a revision of the methodological recommendations.

Sources

Abbreviations
DARE- Database of Abstracts of Reviews of Effects
HSPROJ- Health Services Research Projects in Progress
HSTAT- Health Services/Technology Assessment
HTA- Health Technology Assessment
NEED- Health Services Research Projects in Progress
QUS- Quantitative Ultrasound

P. Aidelsburger, F. Hessel, S. Felder, J. Wasem.
(1) Alfried Krupp von Bohlen and Halbach Foundation, University of Duisburg-Essen, Essen, Germany (2) Faculties of Medicine and Economics, University Clinic, ISMHE, Magdeburg, Germany
A methodological approach to assess cost due to dying in the context of decision analytic modelling

P. Aidelsburger (1), J. Wasem (1)
(1) Alfred Krupp von Bohlen and Halbach Foundation, University of Duisburg-Essen, Essen, Germany

Objectives

• Decision analytic modelling is a method to evaluate the cost-effectiveness of an intervention considering short and long term effects and costs. Therefore data of different sources and of different evidence is used. In decision analytic modelling patients might change health states until they die due to disease specific causes or due to unspecified causes (reflecting background mortality). All health states will have a specific health outcome (e.g. QALY) and specific costs.

• Treatment costs in the last two years before dying are exceptionally high. In a decision analytic model this fact should be accounted for by adding costs due to dying once a patient is changing from one health state to the health state „death due to disease specific causes“ or „death due to unspecified causes“.

Research objective was to calculate terminal costs for disease specific causes (e.g. Hepatitis C related causes) and unspecified causes („background mortality“).

Methods

The general idea was to calculate the costs of the last inpatient treatment before death and to add these costs once, in the moment a patient is entering the health states „death of unspecified causes“ or „death of disease specific causes“. In this way they are applicable in decision trees as well as in Markov models.

Procedure

Costs were calculated by multiplying the hospital length-of-stay of the terminal inpatient treatment with administrative per diem costs consisting of prices of general rate and departmental rate (internal medicine used for patients ≥15 years and pediatrics for patient <15 years).

The determination of hospital length-of-stay varied.

In a first step age was not considered. In the calculation of costs due to „death of unspecified causes“ the most common diagnoses (with a coverage of 75% of all death in the year 1999) have been considered. The average hospital length-of-stay was calculated by weighting the hospital length-of-stay of one disease by the proportion of patients that died of this disease. The calculation of age specific costs of dying of unspecified causes considered the ten most common diagnoses in the particular age group.

Costs due to „disease specific causes“ have been calculated at the example of Hepatitis C related diseases. All relevant ICD 9 codes have been identified first. For these diagnosis non age specific and age specific costs have been calculated as described above.

Perspective

A hospital perspective was taken

Sources

• Terminal hospital length-of-stay of specific diseases (ICD 9 encoded): Federal Statistical Office Germany (Diagnosedaten der Krankenhauspatienten KH-DIAG99, basic year: 1999)
• Number of death due to a specific disease in the year 1999 (ICD 9 encoded): Federal Statistical Office Germany (Diagnosedaten der Krankenhauspatienten KH-DIAG99, 1999)
• Prices of general rate and departmental rate: annual report of the Association of Private Health Insurers, 2001

Results

Without considering age the average costs of the terminal inpatient treatment of Hepatitis C specific causes is 3.422 EURO, of unspecified causes 3.076 EURO.

The age specific average costs of the terminal hospital stay are presented in table 1. Over the age of 15 years costs of dying are similar for disease-specific causes and unspecified causes. Differences can be found in the age groups lower than 15 years, with much higher costs for Hepatitis C related causes.

The demonstrated costs are additional costs and should be applied once, in the moment a patient enters the health states „death of unspecified causes“ or „death of disease specific causes“. In this way they are applicable in decision trees as well as in Markov models.

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>unspecified causes</th>
<th>disease specific causes (Hepatitis C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>7.645</td>
<td>19.987</td>
</tr>
<tr>
<td>5-14</td>
<td>8.011</td>
<td>13.018</td>
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<td>15-24</td>
<td>3.308</td>
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<td>25-34</td>
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<td>35-44</td>
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<td>45-54</td>
<td>3.336</td>
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<tr>
<td>55-64</td>
<td>3.301</td>
<td>3.440</td>
</tr>
<tr>
<td>65-74</td>
<td>3.052</td>
<td>3.577</td>
</tr>
<tr>
<td>&gt;74</td>
<td>2.566</td>
<td>3.353</td>
</tr>
</tbody>
</table>

Conclusion

The demonstrated approach is a pragmatic way to assess terminal costs due to dying of different causes using pre-existing statistical data. It is easily transferable and adaptable for different decision analytic models in the german health care sector.

Nevertheless a couple of limitations exist.

Costs due to dying are still underestimated, as just the additional costs in consequence of the last inpatient treatment before death are considered. As it is shown in the literature costs before death will rise in the last two or three years of life. In the cost calculation just the departmental rate of an internal ward have been considered for all cases. By ignoring e.g. surgical ward and intensive care units prices are underestimated.

The statistical data of the Federal Statistical Office Germany are based on the year 1999. Hospital length-of-stay as well as the number of death due to a specific disease will not have altered significantly in the last 5 years. For this reason the bias is expected to be of low effect.

Due to the taken perspective costs for outpatient treatment and and home care are not considered but certainly will contribute to the terminal costs to a high percentage.

Further research is necessary to evaluate the real costs in the terminal years for the whole population and for specific diseases.