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## Implications of learning-by-doing effects on economic evaluation: the case of lung transplantation

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**Objectivos (Objectives):** Learning-by-doing or quality-enhancing scale economies have been well documented in the literature. Several procedures require high skills from physicians, which they improve over time with consequences on patients' outcomes. In the present paper, we discuss the implications of learning-by-doing effects on economic evaluation using the case of lung transplantation in Portugal. Lung transplantation has been performed in Portugal since 2000 at a single centre.

**Metodologia (Methodology):** Data were collected for all patients waiting for transplantation since the 31st of December 2000 until the 31st of December 2010 (n=61). Patients waiting for transplantation were used as comparison group. Regarding benefits, we calculated average survival time using Kaplan-Meier estimation method. For censored observations with more than one year survival time, we artificially added 6.5 life-years, based on results from the literature. Regarding costs, we calculated the average of direct medical costs for the first and second year after treatment and assumed average costs would be constant in subsequent years. Costs were discounted using a 5% factor. Survival data for patients waiting for transplantation were not available given that most patients acceded the treatment in a short time. Hence, data on average survival time for patients on waiting lists were obtained from a systematic review of the literature, i.e. an average survival of 2.7 life-years. Data from literature were also used for utilities, in order to calculate QALYs, 0.31 and 0.74 respectively for patients waiting for and after transplantation. Costeffectiveness ratios were calculated first for the whole period (2001-2010). Then they were calculated for each year considering previous periods only (that is, considering the 2001-2004 period, then the 2001-2005 period, and so on). Finally, ratios were calculated excluding one by one the oldest years (that is, considering the 2002-2010 period, then the 2003-2010 period, and so on). These calculations were performed first using life-years gained as consequences and then QALYs.

**Resultados (Results):** We show that, although costs have been relatively constant between 2000 and 2010, outcomes have been substantially improving over the same period, from 569 days for the 2001-2004 period to 1,281 days for the 2001-2010 period. Along the same idea, survival time increases to 1,687 days for the 2007-2010 period, when the number of transplantations (n=29) were 70% of the total. As a consequence, cost-effectiveness of lung transplantation has been constantly improving too. For the 2007-2010 period, the cost of lung transplantation is of 129,534€ and the incremental cost compared with patients in waiting lists is of 118,756€ for an incremental benefit of 1.92 life-years or 2.58 QALYs. The incremental cost-effectiveness ratio is of 61,852€ per life-year gained or 45,997€ per QALY. Ratios become more favorable over the time.

**Conclusões (Conclusions):** Results from the literature show that, although values are relatively high, lung transplantation is cost-effective according to commonly accepted thresholds in the US or in the UK. The present study emphasizes that economic evaluation requires a careful evaluation of the context where the intervention is performed, in particular the experience of specialized services. Our results show the relevance of a continuous re-evaluation of procedures along time, in particular for complex procedures, as lung transplantation, that require high skills, sophisticate equipment and organization. Indeed, early evaluations may be biased by the incomplete learning process, potentially leading to erroneous decisions. More generally, our results advocate for an extension of observational studies in order to identify such effects and caution in economic evaluation based on small groups and for very preliminary practices.