Model-Based Decision Making in Cardiac Surgery

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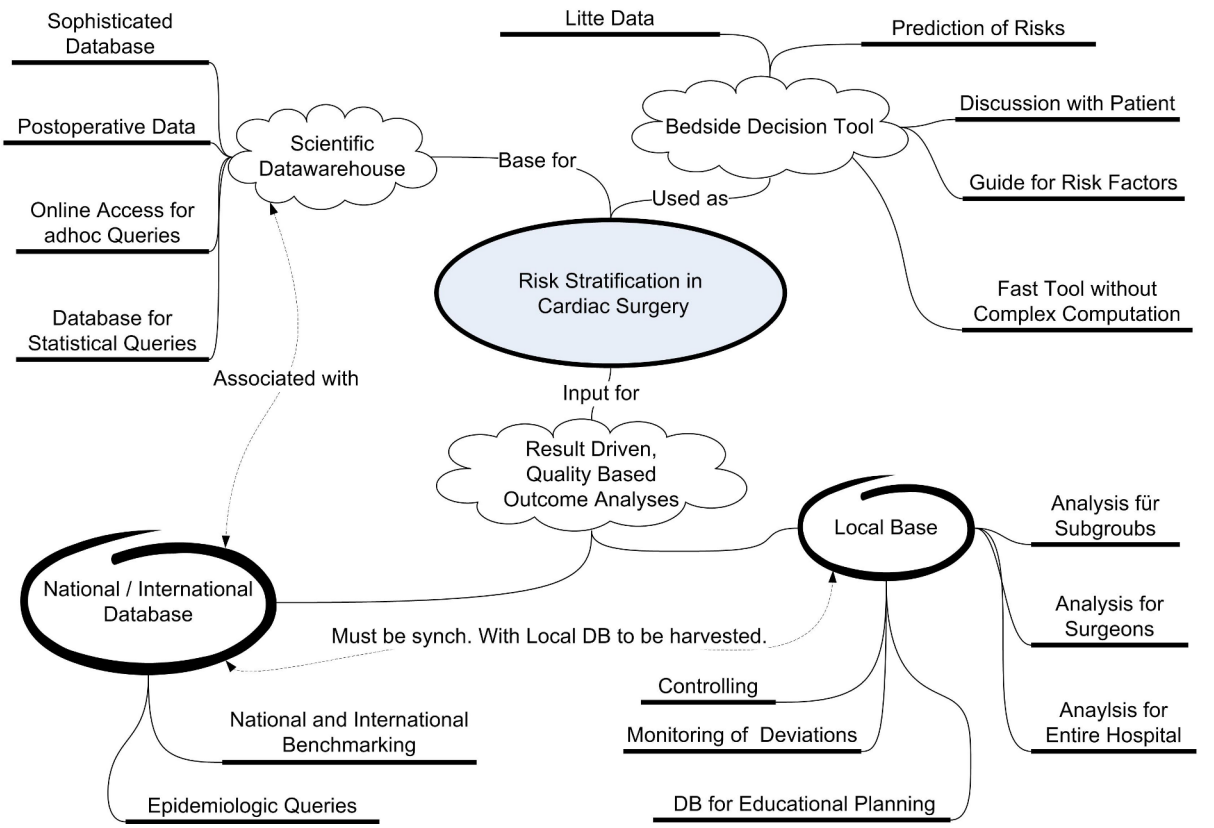
INTRODUCTION

The development of models for risk stratification in cardiac surgery goes back a number of years. In 1989, the Society of Thoracic Surgeons (STS) created the first database version for use in the USA. In the year 2005 alone, the data from 234,532 operations were recorded in a structured way by 654 participating institutes. The value of these collected data is described by Ferguson (Ferguson, Dziuban, Edwards, Eiken, Shroyer, & Pairolero, 2000): "Because of their collective efforts, the goal to establish the STS National Data Base as a 'gold standard' worldwide for process and outcomes analysis related to cardiothoracic surgery is becoming a reality." The number of research projects deriving from this is correspondingly large (The Society of Thoracic Surgeons National Database Access and Publications Task Force, 2006).

In the meantime, heart registers have been set up in many countries including, for example, the USA, Canada, the UK, and Australia (Smith, 2001). As a data pool of scientific studies for the construction of new models for risk stratification, these have been used for a number of years as a suitable means of achieving qualitative improvement in the outcome and patient satisfaction, and for raising the quality and cost effectiveness of cardiac surgical interventions (Gale, 2001). After a long-term study of the outcomes of risk stratified patient groups, Grovers concludes: "It appears that the routine feedback of risk-adjusted data on local performance provided by these programs heightens awareness and leads to self-examination and self-assessment, which in turn improves quality and outcomes. This general quality improvement template should be considered for application in other settings beyond cardiac surgery." (Grover, Shroyer, Hammermeister, Edwards, Ferguson, Dziuban, et al., 2001)

However, the methods of risk stratification are used not only for scientific investigations. Although very controversial, some of the countries with a national heart register started publishing the results of outcome analyses at a very early stage. Green (Green & Wintfeld, 1995) had already summarised the situation in 1995: "Publication of 'report cards' on hospitals and surgeons is an important new trend. The New York State Department of Health pioneered this practice by developing the Cardiac Surgery Reporting System (CSRS), which generated the first physician-specific mortality report ever published. This controversial report and its annual updates have received intense publicity, because the results indicated that the percentage of patients who died after heart surgery differed widely among surgeons, even after adjustment for differences in the patients' attributes. In addition, risk-adjusted death rates for coronary-artery bypass grafting (CABG) reportedly declined in New York after CSRS had been

Figure 1. Aspects of risk stratification in cardiac surgery



implemented, leading some people to conclude that such systems may save lives."

Publication of the outcome down to the level of individual surgeons also takes place in the UK. In Australia, publication of the results is done on the basis of regional centres (Neil, Clarke, & Oakley, 2004).

Even though the risk stratification performed on risk models, the data pool on which these are based, and the methods for determining scoring systems are not undisputed (Iezzoni, 1997; Omar, Ambler, Royston, Eliahoo, & Taylor, 2004), in addition to the predominantly risk-group oriented statements on result quality, the results of the predictive models are also used for supporting decision making with respect to chances and risks, for ensuring that all risk factors are ascertained and, last but not least, as a basis for the discussion between surgeons and patients for or against a specific intervention (Bernstein & Parsonnet, 2000;Mauro, Kline-Rogers, Share, O'Donnel, Maxwell-Edward, Meengs, et al., 2001) .

The multiple objective associated with risk stratification exerts fundamental influence on selection of the score and on the data to be gathered, and results in the derivation of specific technical requirements of the system design.

BACKGROUND

In medicine, the term "risk stratification" means the estimation of the risk of a disease progressing or leading to complications or death. In order to do this, risk factors are recorded that are known to be associated with the progression of a disease or with the occurrence of complications. Based on the individual risk profile, tables, algorithms, or computer programs are used to determine the individual risk of the patient. (Wikipedia, Risk stratification)

Distinctive factors characteristic of the person, their surroundings (environmental factors) or their diet that raise the risk of one or more diseases to an extent significantly above the general risk of disease are designated as health risk factors. Medical findings, a laboratory value or a specific type of behaviour by the