

Chapter XX

Data Mining Techniques and Medical Decision Making for Urological Dysfunction

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ABSTRACT

Data mining has been emerging recently as a viable computational tool for autonomous decision making especially in the field of medical applications. It has provided diagnostic solutions for skin and breast cancer detection, brain tumor detection, and also for other classification problems. In this chapter, we explore two data mining techniques, namely, association mining and decision tree mining, for predicting the life span of the kidney failure patients who have undergone routine dialysis. The total parameters used for this study were 28 attributes. The optimal prioritized parameters that decide the survival rate are reported and it can be concluded from the experimental results that the decision tree approach yields promising results.

INTRODUCTION

The process of extracting useful information from a set of data is called data mining. Data mining techniques have been used as a recent trend for gaining diagnostics results, especially

in medical fields such as kidney dialysis, skin cancer and breast cancer detection, and also biological sequence classification (Fernando, Juan, & Angel, 2002; Krzysztof & William, 2002; Kusiak, Dixon, & Shah, 2005; Linhua et al., 2004). It is well known that the primary

problem for urological dysfunction is acute and chronic renal failure, which can be treated through dialysis. This chapter describes the data mining techniques for predicting the life span of a kidney dialysis patient. Since we are interested in predicting the output for each individual, data mining tools have been opted as the decision making tools due to their individual-based functionality compared to other analysis tools, which are population based. They offer a valid, novel, and helpful solution for the identification of patterns of data, and also develop high-confidence predictions for each individual. Given the predicted outcome, more and better treatments can be made available for every individual. Furthermore, the resulting output serves as a major contribution to medical-care centres in providing enhanced treatment to kidney-dialysis patients to prolong their life spans. Therefore, it is hoped that the application of these techniques could provide us a rough estimation for the survival prediction of dialysis patients based on certain weighed parameters. About 29 parameters were considered as data from the database of kidney patients to provide an effective estimate of one's survival length after kidney failure.

KIDNEY FAILURE AND DIALYSIS

The kidney plays an important role in the body due to its basic functionality of processing all toxic waste together with excess water and salt. Generally, it is an organ that filters about 189 liters of liquid from the blood (1% original filtrate, which appears in the final urine as waste product and water). These waste products that are produced from food tissue are urea and creatinine. However, its main ability is to retain a proper stability of extra cellular fluid (ECF) and electrolyte homeostasis. This process can be done by maintaining the secretion

of water and electrolytes to balance the changes (Sherwood, 1993). For a person with kidney failure, waste products that are produced from food tissue, namely, urea and creatinine, start accumulating in the body, and hence the fluid level and water homeostasis will be imbalanced. This eventually leads to endocrine failure and results in death.

Dialysis refers to any medical treatment that aims at replacing normal kidney function by artificial means. The treatment is prescribed for patients with end-stage renal failure (ESRF). Dialysis is an effective life-saving treatment. Without dialysis, the life expectancy for a patient with ESRF is less than a year. Life expectancy on treatment may be as long as 16 years, depending on the age and health status of the patients. There are about 370,000 kidney patients who are undergoing treatment for dialysis, and its annual cost is \$11.1 billion in the United States of America (Kusiak, Dixon, et al., 2005; U.S. Renal Data System [USRDS], 2002). Even though the number of kidney patients has been rising yearly with a growth rate of 6%, little attention is given to kidney health. Out of the figure mentioned above, the total number of patients suffering from chronic renal failure is 260,000, and about 50,000 patients die yearly (Cooper, 1999; Kusiak, 2004; USRDS). When the kidney is functioning at less than 50% of its normal capacity, it eventually leads to chronic renal failure. In the end stage of renal failure, kidney function is at less than 10 to 15% of normal capacity. In Malaysia at the end of 2002, a total of 2,223 patients were accepted for dialysis compared to 43 patients in 1980, and prevalent dialysis patients increased rapidly from a total 59 in 1980 to 8,954 in 2002 (Zaki et al., 2003). The acceptance rate for dialysis increased very rapidly from 3 per 1 million to 91 per 1 million in 2002. Death rates for haemodialysis have remained at 10% or lower per year throughout the years from 1980 to

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