The methods and results presented in this thesis have the potential to improve patients' lives by allowing clinicians and researchers to better explore bivariate associations between random variables, e.g. clinical outcomes.

Such improvements can be achieved via firstly having a better understanding of the limitations of correlation coefficients. Secondly, by appreciating the enhancements local dependence functions can bring as well as alternative graphical displays that
complement the conventional scatterplot. Thirdly, via multivariate distribution functions that can capture a wide range of association patterns and strengths between two or more random variables.

Copula models are a flexible tool that can be used for the construction of multivariate distribution functions and allow the exploration of varying relationships across the range of the two rvs. Informing healthcare professionals, including paediatricians, about these models will advance their understanding of multivariate relationships and enable them to construct more in-depth and flexible models for associations of variables and their joint characteristics.

Moreover, healthcare professionals often need to evaluate patients' individual or combined results and classify them according to whether they fall inside or outside a normal range of values (normal range is defined as a range within which the vast majority of the population lies). When two or more individual results are available, it would be beneficial to be able to classify patients according to whether they fall within a multivariate normal range or not, rather than evaluating multiple univariate ranges. Using a multivariate normal range is expected to reduce the number of false positive results, i.e. patients falsely being classified as unusual according to multiple individual tests which might in fact be within the normal range when jointly considered. The use of a multivariate range will also enable the identification of unusual cases that might have been missed based on univariate centiles alone, resulting in the identification of hidden extremes.

This thesis reviews the empirical exploration of bivariate associations, including conditional models, and showcases a new classification method for extreme values. This new method has the potential to become a conventional tool for everyday use in a healthcare setting that will enable its users to make better informed choices regarding unusual observations within a sample of subjects.

The applicability of the results from this thesis are not limited to healthcare professions. Greater flexibility in the investigation of bivariate associations and the ability to identify unusual observations in a multivariate setting is likely to have wider applicability.