

Complex patient phenotypes in critically care associate with high mortality rates in sepsis.

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Background. Rapid uptake of electronic health records is yielding high dimensional databases. Our research capitalizes on such datasets to create complex phenotypes thereby improving prognosis, treatment decisions and outcomes. Sepsis remains a major challenge of healthcare and with the aging population chronic conditions are increasingly prevalent, occurring frequently in combinations (“multimorbidity”). Furthermore, current models of clinical training, practice and research hold a single disease focus. Thus, it is imperative we incorporate multimorbidity in healthcare models. In this study our aim is to discover complex patient phenotypes in the critically ill, that are susceptible to sepsis and related mortality.

Methods. Retrospective review of single center patient cohort from the MIMIC III dataset. A total of 36390 patients were reviewed. Morbidities were represented using Elixhauser categories, a well-established scheme distinguishing 30 classes of chronic diseases. We used latent class analysis (LCA) to identified clinically distinct patient phenotype which shared characteristics in demographics, admission type and composition of chronic diseases.

Results. We identified six clinically distinct phenotypes. The “cardiovascular”, “complicated diabetes” and “consequences of addiction” phenotypes had relatively higher prevalence of sepsis and related mortality. The “consequences of addiction” had the greatest rate of sepsis and mortality, and was characterized by middle-aged patients (mean age of 52.25, 95% CI 51.85-52.65) with the high rates of depression (20.1%), alcohol abuse (47.75%), drug abuse (18.2%), and liver failure (67%).

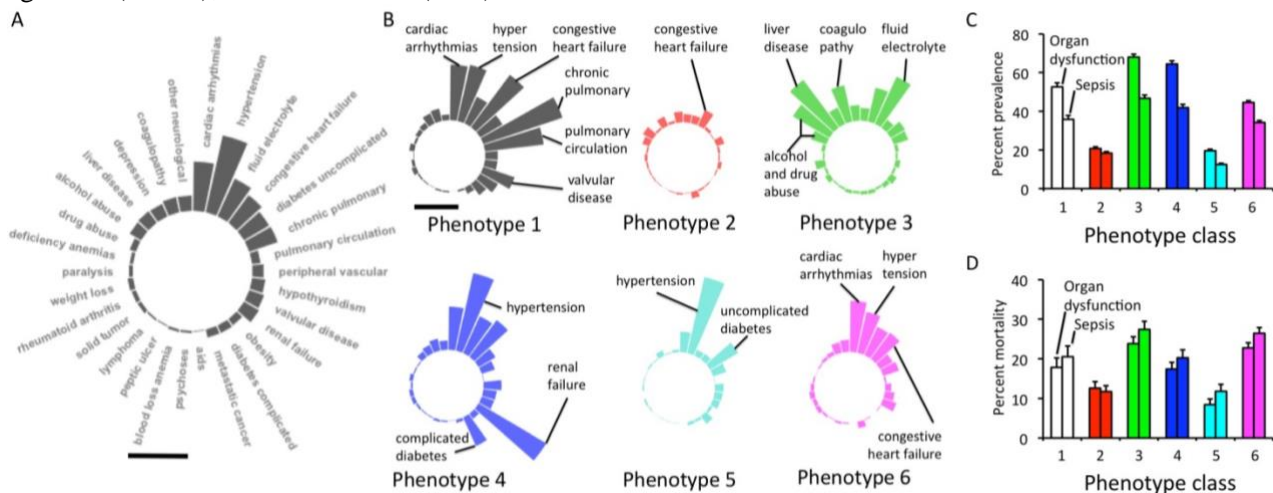


Figure 1: A: Prevalence of Elixhauser's multimorbidity phenotypes for the entire cohort of 36960 patients. Bar=50%. B: Circular barplot summary of disease composition of morbidity classes in critical care. Plot configuration is identical to “A”. Note the distinct patterns such as the complex cardiopulmonary profile in phenotype 1, health consequences of addiction in phenotype 3 and diabetic nephropathy with hypertension in phenotype 4. Bar=50%. C and D: Prevalence of organ dysfunction, sepsis and associated mortality are highest in phenotype 3. (all differences are significant with multiple testing, $p < 0.001$)

Conclusion: We identify complex patient phenotypes with distinct morbidity compositions, susceptibility to sepsis and related mortality. The findings promote updating the single disease model used in healthcare and provide basis for our future work to integrate disease features with patient phenotype to create complex phenotypes.

Reference: Zador Z, et al. Multimorbidity states associated with higher mortality rates in organ dysfunction and sepsis: a data-driven analysis in critical care. *Crit Care*. 2019;23:247.