# Title: Consequences of Early-onset type 2 Diabetes

*Introduction*

Type 2 Diabetes Mellitus (T2DM) has emerged as a significant health concern in the 21st century, carrying substantial societal consequences on a global scale. In the United States, the prevalence of diabetes among individuals of all age groups was recorded at 37.3 million, accounting for approximately 11.3% of the total population. (NIH, 2023) Notably, a considerable proportion of this diabetic population, estimated to be 2.4%, falls between the age range of 18 to 44 years. (CDC, 2023)

However, T2DM has traditionally been recognized as a disease of the middle-aged and elderly, but since the 2000s, with the greatest relative increases in DM2 in younger adults (<40 years). It is well known that DM, either type 1 or 2, is associated with increased morbidity and mortality due to complications affecting almost all body organs.

Worryingly, individuals diagnosed at a younger age seemingly have a more rapid deterioration of β-cell function than those with later-onset DM2 and an increased risk of complications compared with those with T1DM, suggesting a more aggressive disease phenotype2. Furthermore, DM2 in adolescents (10-19y) manifests as a severe progressive form of diabetes that frequently presents with complications, responds poorly to treatment, and results in rapid progression of microvascular and macrovascular complications. In addition, early -onset T2Dm are twice likely have any macrovascular complications and 14-fold higher hazard of developing myocardial infarction compared to the usual-starters. [[1]](#footnote-1)

Therapeutic options are heavily curtailed by a lack of knowledge about the condition, with low numbers and poor trial recruitment impeding research. Together with lifestyle modification, metformin remains the first-line therapy, although the majority rapidly progress to treatment failure and insulin therapy. [[2]](#footnote-2)Adolescents/young adults with Type 2 diabetes lose approximately 15 years from average remaining life-expectancy and may experience severe, chronic complications of T2DM by their 40s.[[3]](#footnote-3)Therefore, young and early-onset T2DM now presents a challenge across many health systems and unclear uncertainties.

It is well-recognized that the management of people with diabetes in an ICU is particularly challenging. To this situation, we have to add that co-morbidities, such as cardiovascular disease, hypertension, and obesity, very often accompany diabetes. Moreover, there are several other conditions and co-morbidities often present in diabetes, such as peripheral vascular disease, neuropathy, and retinopathy[[4]](#footnote-4). The percentage of visits for patients aged 45 and over, 45–64, and 65 and over with diabetes that ended in inpatient hospital admission was significantly higher than the percentage of visits for those in these age groups without diabetes with this discharge disposition.[[5]](#footnote-5)

In recent years, there has been a concerted move towards the adoption of digital health record systems in hospitals. In the US, nearly 96% of hospitals had a digital electronic health record system (EHR) by 2015. Retrospectively collected medical data has increasingly been used for epidemiology and predictive modeling. The latter is partly due to the effectiveness of modeling approaches on large datasets. Despite these advances, access to medical data to improve patient care remains a significant challenge. While the reasons for limited medical data sharing are multifaceted, concerns around patient privacy are highlighted as one of the most significant issues. Uniquely, the MIMIC-III database adopted a permissive access scheme, allowing for broad data reuse. This mechanism has been successful in the wide use of MIMIC-III in a variety of studies ranging from assessment of treatment efficacy in well-defined cohorts to prediction of key patient outcomes such as mortality. Therefore, based on the MIMIC IV database, this study aims to examine ICU utilization and outcome prediction for a younger population with DM2. And the study hypothesizes that there will be no differences between early and later-onset DM2 ICU utilization and outcomes.

*Methods*

Data were extracted from Medical Information Mart for Intensive Care (MIMIC IV) data using SQL queries. The MIMIC-IV database includes data from Beth Israel Deaconess Medical Center’s ICU and Hospital from 2008 to 2019 of over 40,000 patients. This database has comprehensive information regarding ICU admissions and all the data needed to address this question. Data from MIMIC-IV detailing admissions, medications, ICU stays, ICD-9-CM diagnoses, and lab values were selected. First, all patients with an ICD-9-CM diagnosis of 250.0 – 259.0 (diabetes inclusive) were selected. Diabetes Mellitus type I under ICD codes 250.01, 250.11,250.13, 250.41, 250.43, 250.51, 250.53, 250.61, 250.63, 250.71, 250.73, 250.91, 250.93 excluded from the cohort. Additionally, DM2-diagnosed patients contain no LOINC codes of ‘4548-4 for HbA1c’ and ‘6777-7 for Blood Glucose’ in *events*.

A dataset was created that contained the following data: baseline demographic information such as age, BMI, sex, weight, and ethnicity; clinical parameters including vital signs, hospital stay, ICU stay, and survival status; laboratory tests and scores on disease scoring systems including Sequential Organ Failure Assessment (SOFA).???

Elixhauser Co-morbidity Idex -category of co-morbidity, one point for each co-morbidity

Diabetic Severity Index -diabetic patients+renal labs

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Early-onset DM2 is considered DM2 under 40 years of age; therefore, the study divided DM2 patients into two groups, the early-onset DM2 and the late-onset DM2 groups and compared the outcomes. The detailed process of data extraction is shown in Table 1.

*Table1. Process of data extraction*

A diagram of a data gathering flow chart

Description automatically generated

*Results*

*Table2.*

**Variables:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Covariates** | **DM Type II** | | **P value** |  |
| Early-onset <40years | Late-onset <41 years |  |  |
| Age(years) |  |  |  |  |
| BMI |  |  |  |  |
| <18.5 |  |  |  |  |
| 18.5 – 24.9 |  |  |  |  |
| 25.0 – 29.9 |  |  |  |  |
| >30.0 |  |  |  |  |
| Gender no.(%) |  |  |  |  |
| Male |  |  |  |  |
| Female |  |  |  |  |
| Ethnicity, no.(%) |  |  |  |  |
| Asian |  |  |  |  |
| Black |  |  |  |  |
| Hispanic/Latino |  |  |  |  |
| White |  |  |  |  |
| Other |  |  |  |  |
| Marital status, no.(%) |  |  |  |  |
| Married |  |  |  |  |
| Single |  |  |  |  |
| Other |  |  |  |  |
| Insurance,no.(%) |  |  |  |  |
| Medicaid |  |  |  |  |
| Medicare |  |  |  |  |
| Private |  |  |  |  |
| Non/self-pay |  |  |  |  |
| Other |  |  |  |  |
| Admission type,no.(%) |  |  |  |  |
| Elective |  |  |  |  |
| Emergency |  |  |  |  |
| Urgent |  |  |  |  |
| Monitoring |  |  |  |  |
| Heart rate (bpm) |  |  |  |  |
| MAP (mmHg) |  |  |  |  |
| Respiratory rate |  |  |  |  |
| SPO2 (%) |  |  |  |  |
| Lab results |  |  |  |  |
| Glucose (mg/dL) |  |  |  |  |
| WBC (×109） |  |  |  |  |
| Creatinine (mg/dL) |  |  |  |  |
| Hemoglobin (g/L) |  |  |  |  |
| Platelet (×1012) |  |  |  |  |
| HBA1C（%） |  |  |  |  |
|  |  |  |  |  |
| Preadmission medications | | | | |
| Statin |  |  |  |  |
| Insulin |  |  |  |  |
| Metformin |  |  |  |  |
| Other |  |  |  |  |
|  |  |  |  |  |
| Primary reason of admission, |  |  |  |  |
| Infectious |  |  |  |  |
| Cardiovascular |  |  |  |  |
| Respiratory |  |  |  |  |
| Cancer |  |  |  |  |
| GI |  |  |  |  |
| GU |  |  |  |  |
| Trauma |  |  |  |  |
| Treatment complication |  |  |  |  |
| Other |  |  |  |  |
|  |  |  |  |  |
| DM complications |  |  |  |  |
| DM uncomplicated |  |  |  |  |
| DM complicated |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Co-morbidity |  |  |  |  |
| CHF |  |  |  |  |
| Mental Health |  |  |  |  |
| Neurological disease |  |  |  |  |
| Hypertension |  |  |  |  |
| Cancer |  |  |  |  |
|  |  |  |  |  |
| Infection-microbiology |  |  |  |  |
| AMR |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Clinical outcomes** |  |  |  |  |
|  |  |  |  |  |
| Mechanical Ventilation? |  |  |  |  |
| SOFA score mean |  |  |  |  |
| ICU mortality |  |  |  |  |
| 30-day mortality, n (%) |  |  |  |  |
|  |  |  |  |  |
| Hospital utilization |  |  |  |  |
| ICU length of stay |  |  |  |  |
| Hospital length of stay |  |  |  |  |
| Imaging studies? |  |  |  |  |
| Dialysis |  |  |  |  |

Bpm: beat per minute, LOS: length of stay, MAP: mean arterial pressure, SOFA: sequential organ failure assessment, WBC: white blood count.

CDC. (2023). Diagnosed Diabetes, Total, Adults Aged 18+ Years, Age-Adjusted Percentage. Retrieved from <https://gis.cdc.gov/grasp/diabetes/diabetesatlas-surveillance.html>

NIH. (2023). Diabetes Statistics. Retrieved from <https://www.niddk.nih.gov/health-information/health-statistics/diabetes-statistics#:~:text=Estimated%20prevalence%20of%20diabetes%20in%20the%20United%20States&text=Diagnosed%3A%2028.7%20million%20people%20of,8.7%25%20of%20the%20population>

1. <https://pubmed.ncbi.nlm.nih.gov/14578230/> [↑](#footnote-ref-1)
2. <https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)31371-5/fulltext> [↑](#footnote-ref-2)
3. <https://pubmed.ncbi.nlm.nih.gov/22150528/> [↑](#footnote-ref-3)
4. <https://journals.sagepub.com/doi/full/10.1177/1932296817706375> [↑](#footnote-ref-4)
5. <https://www.cdc.gov/nchs/products/databriefs/db301.htm> [↑](#footnote-ref-5)