Rising Burden of Diabetic Ketoacidosis in the UK: 23-Year Trends, Recurrence, and Predictors from Linked Primary–Secondary Care Data

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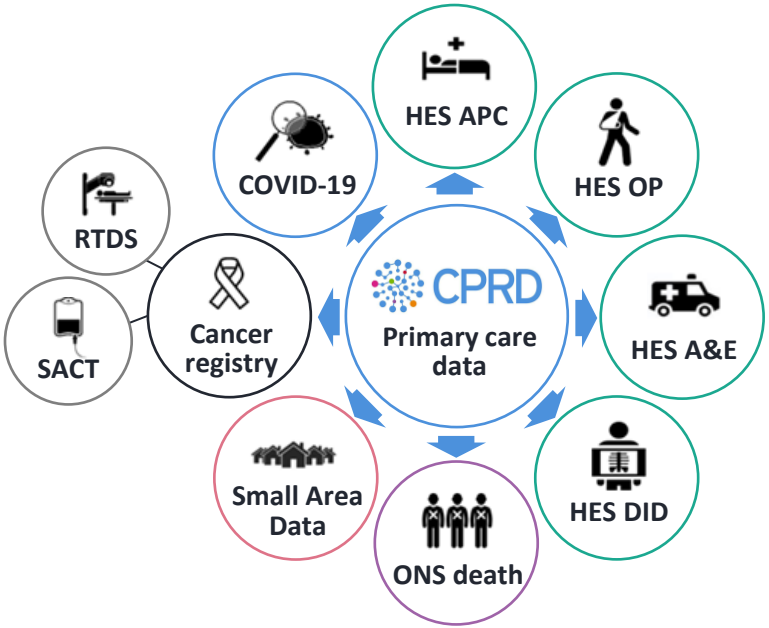
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Methods: Data and linkage



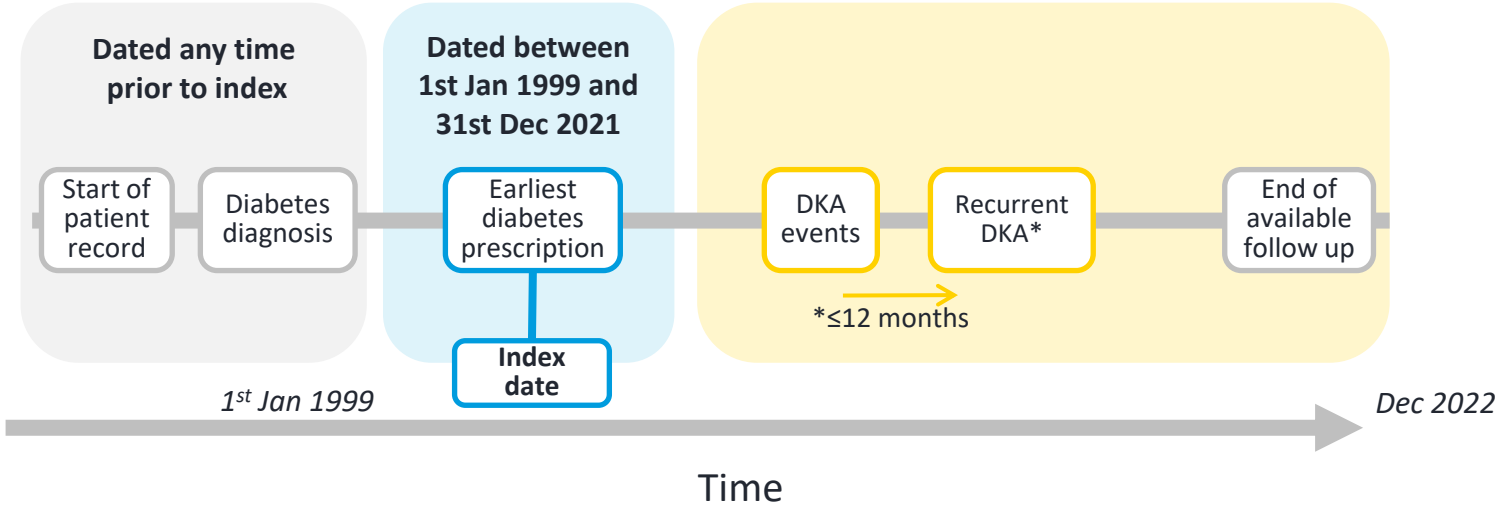
Data: linked Clinical Practice Research Datalink (CPRD), Hospital Episode Statistics (HES), and Office for National Statistics (ONS) databases.

- Includes patients who are registered with a general practice surgery in England or Wales that contributes data to CPRD.
- Data from both CPRD Aurum (~15% of practices) and CPRD GOLD (4.4% of practices).

Further detail on study datasets is available in section 8.3 of Appendix 1 (Study protocol)

Methods: Study design

Retrospective observational cohort study



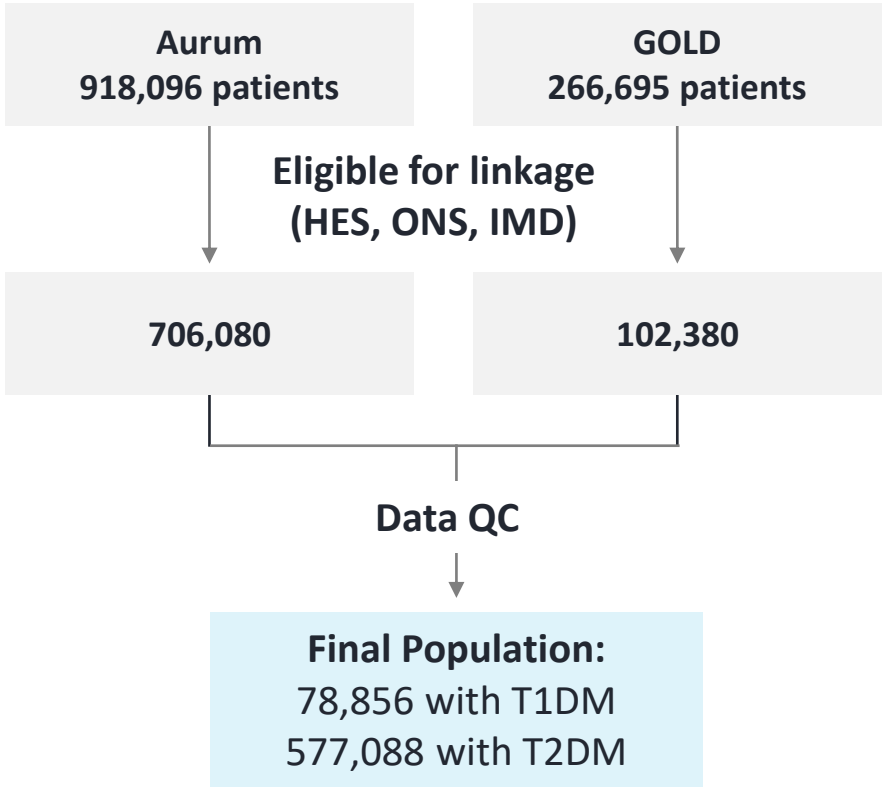
- Index date = earliest glycaemic therapy prescription (start of follow-up);
- Each DKA event is treated as a separate index event for event-level analysis.

Abbreviations: DKA = diabetic ketoacidosis

Study Population

Inclusion criteria:

- T1DM or T2DM
- ≥18 years old
- Prescription for any glycaemic therapy / insulin
- Inclusion from 1st Jan 1999 until 31st Dec 2021



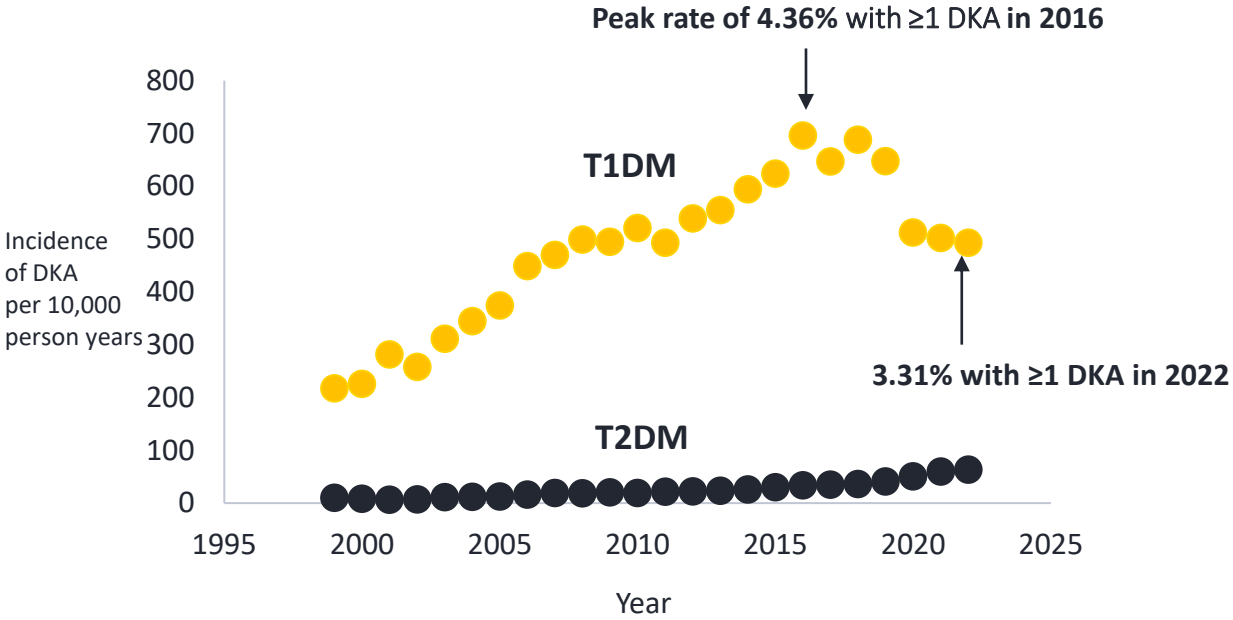
Abbreviations: CPRD = Clinical Practice Research Datalink; HES = hospital episode statistics; IMD = Index of Multiple Deprivation; ONS = Office for National Statistics; QC = quality control

Cohort summary during overall follow-up period

	T1DM	T2DM
Cohort Size (n)	78,856	577,088
DKA Incidence Rate (per 1,000 PY)	51.82	2.81
Proportion with ≥1 DKA event	18.04%	1.78%
Proportion with ≥2 DKA event	8.25%	0.31%
Median (IQR) Follow-Up Time – PY	7.85 (3.7 - 14.2)	7.56 (4.1 - 12.2)

Abbreviations: DKA = diabetic ketoacidosis; IQR = interquartile range; PY = person-years

Reported DKA Events (ICD-coded) by Year



✓ **2014** – *FreeStyle Libre launched (self-funded use begins)*

✓ **2017** – *Early NHS pilots / limited local funding starts*

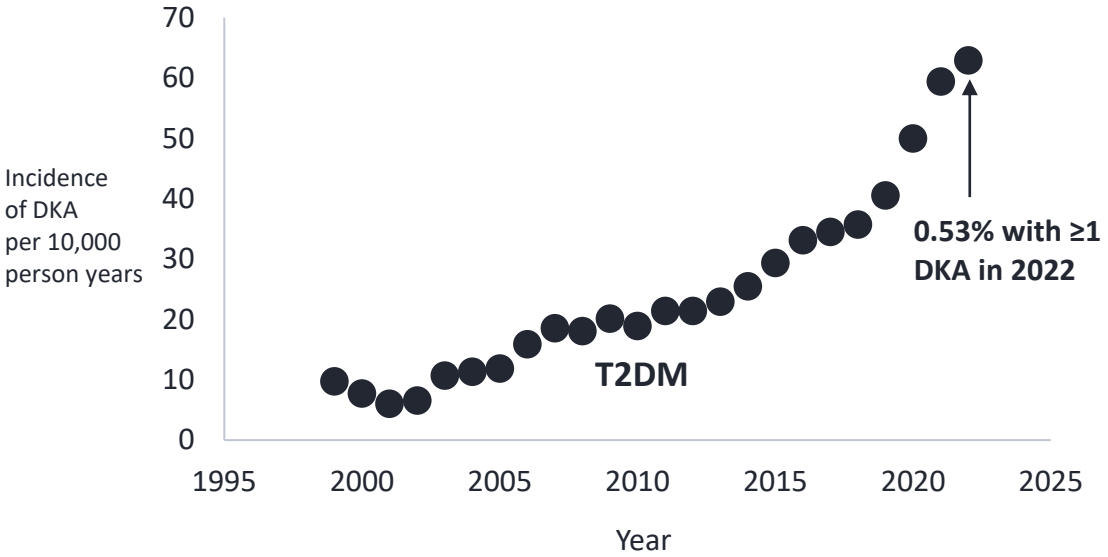
✓ **2019** – *NHS England national rollout of Libre for eligible T1DM*

✓ **2022** – *NICE guidance updated: CGM recommended for all T1DM*

Reported DKA events appear to have increased over time, though earlier rates may reflect underreporting.

Data reflect ICD-coded hospital episodes linked to CPRD; trends may be influenced by changes in coding and management practices
Abbreviations: DKA = diabetic ketoacidosis

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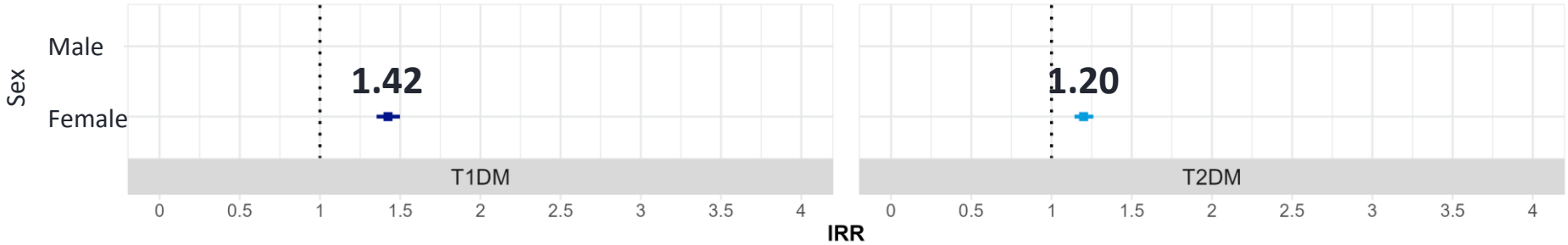
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Incidence of DKA by recent DKA and by sex

IRR of DKA in people with recent previous DKA (≤28 days)

Group	Adjusted IRR (95% CI)	p value
T1DM	**11.0** (9.8 - 12.4)	<0.001
T2DM	**85.4** (69.6 - 104.7)	<0.001

IRR of DKA in females compared to males

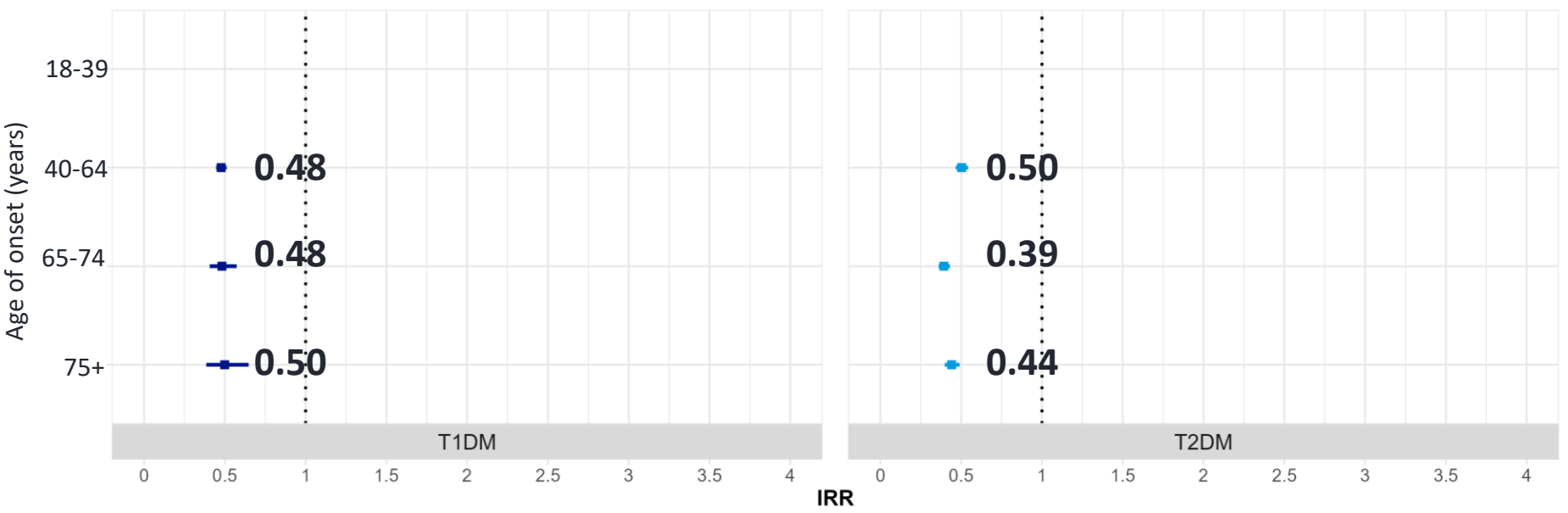


Recent DKA is a powerful predictor of recurrence.
Incidence of DKAs was higher in women than men for both T1DM and T2DM.

Abbreviations: DKA = diabetic ketoacidosis; IRR = incidence rate ratio

Incidence of DKA by age at onset of diabetes

IRR of DKA by diabetes onset age group, compared to age 18-39

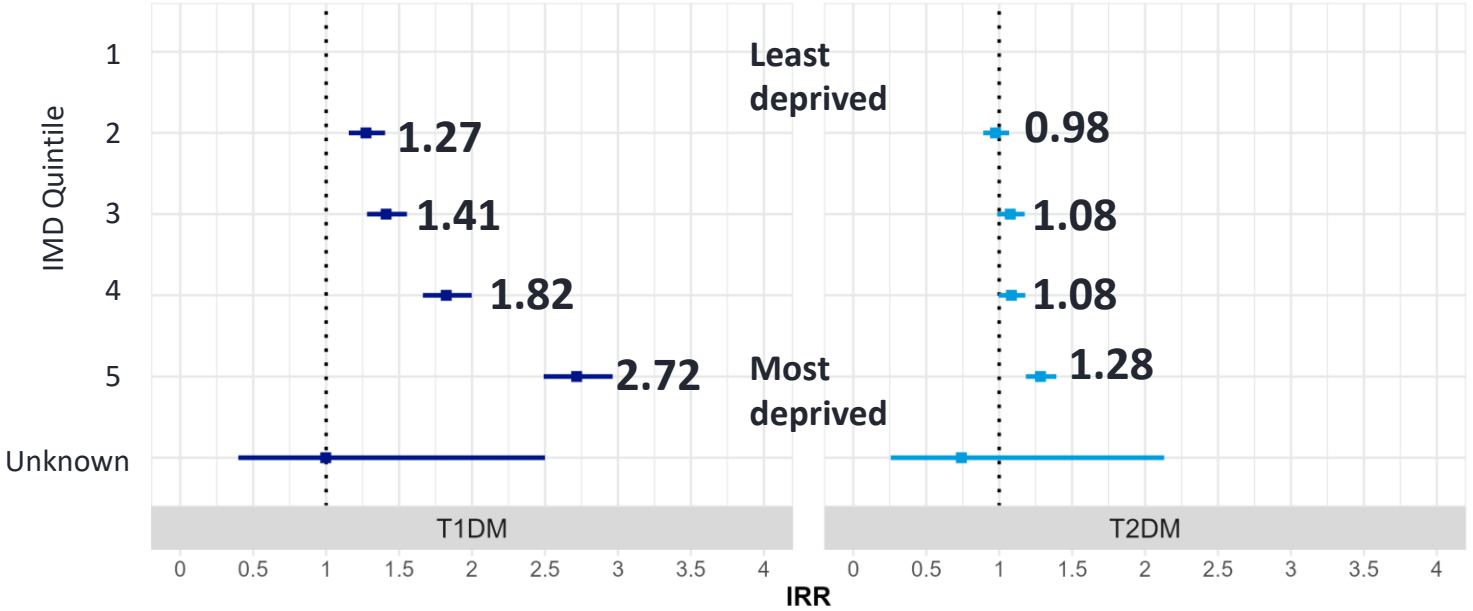


Incidence of DKAs was higher in younger diabetes onset in both T1DM and T2DM

Abbreviations: DKA = diabetic ketoacidosis; IRR = incidence rate ratio

Incidence of DKA by Index of Multiple Deprivation

IRR of DKA by IMD, compared to IMD quintile 1 (least deprived)

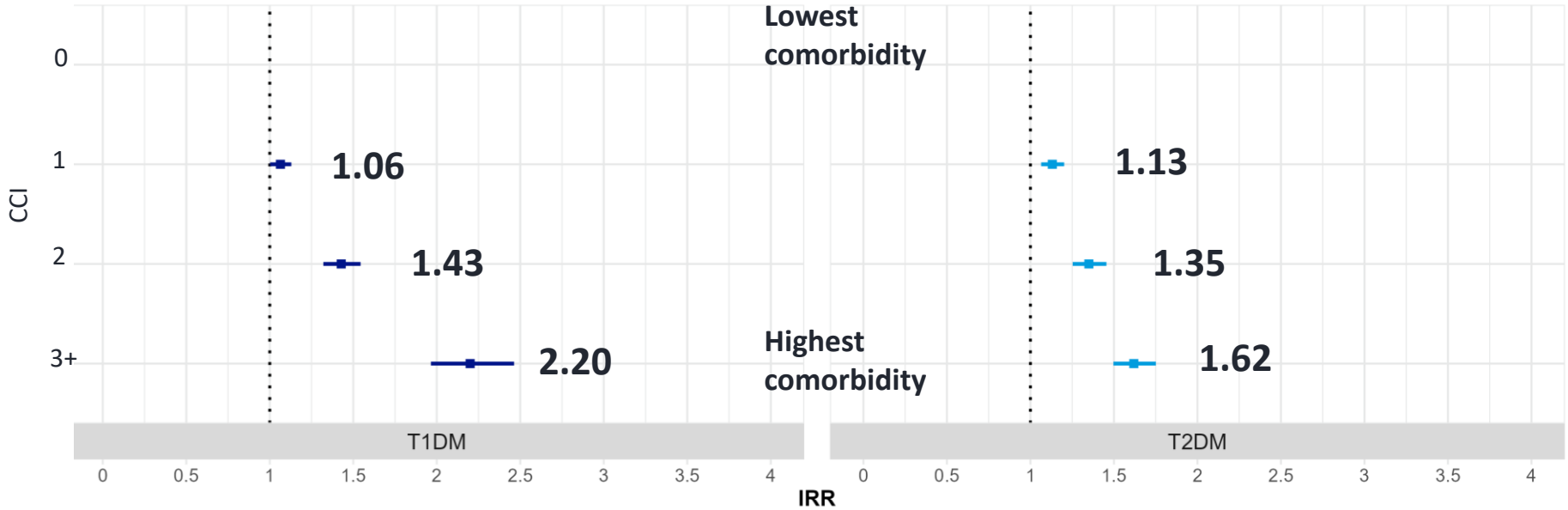


Economic deprivation amplifies DKA risk, particularly for T1DM

Abbreviations: DKA = diabetic ketoacidosis; IMD = index of multiple deprivation; IRR = incidence rate ratio

Incidence of DKA by Charlson Comorbidities Index

IRR of DKA by CCI, compared to CCI = 0 (no additional comorbidities except diabetes)



High comorbidity more than doubles the risk of DKA in T1DM, and it raises the risk in T2DM but to a lesser extent.

Abbreviations: CCI = Charlson Comorbidities Index; DKA = diabetic ketoacidosis; IRR = incidence rate ratio

Conclusion

- **Recent DKA admission** (within 28 days) is the strongest predictor of recurrence (IRR ≈ 11 for T1DM and ≈ 109 for T2DM). Timely post-DKA follow-up may be critical to reduce recurrence.
- **The burden of DKA has risen sharply over the past two decades**, with annual incidence nearly tripling in T1DM and increasing more than fivefold in T2DM. While previous underreporting cannot be ruled out as a contributing factor, the trend may also reflect a significant unmet clinical need.
- **High-risk profiles** include women, younger age of disease onset, those with greater socioeconomic deprivation, and people with multimorbidity (especially T1DM).
- **Action is needed:** proactive strategies such as personalised education and future access to real-time ketone monitoring could help reduce inequalities and prevent recurrence.