



Low Socioeconomic Status is Associated with Adverse Events in Children and Teens on Insulin Pumps Under a Universal Access Program: A population-based Cohort Study

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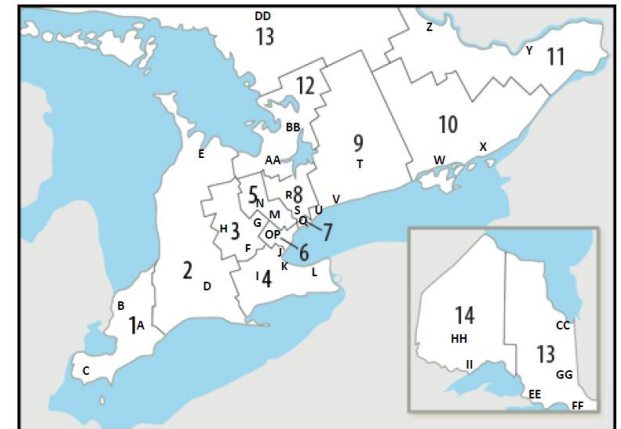
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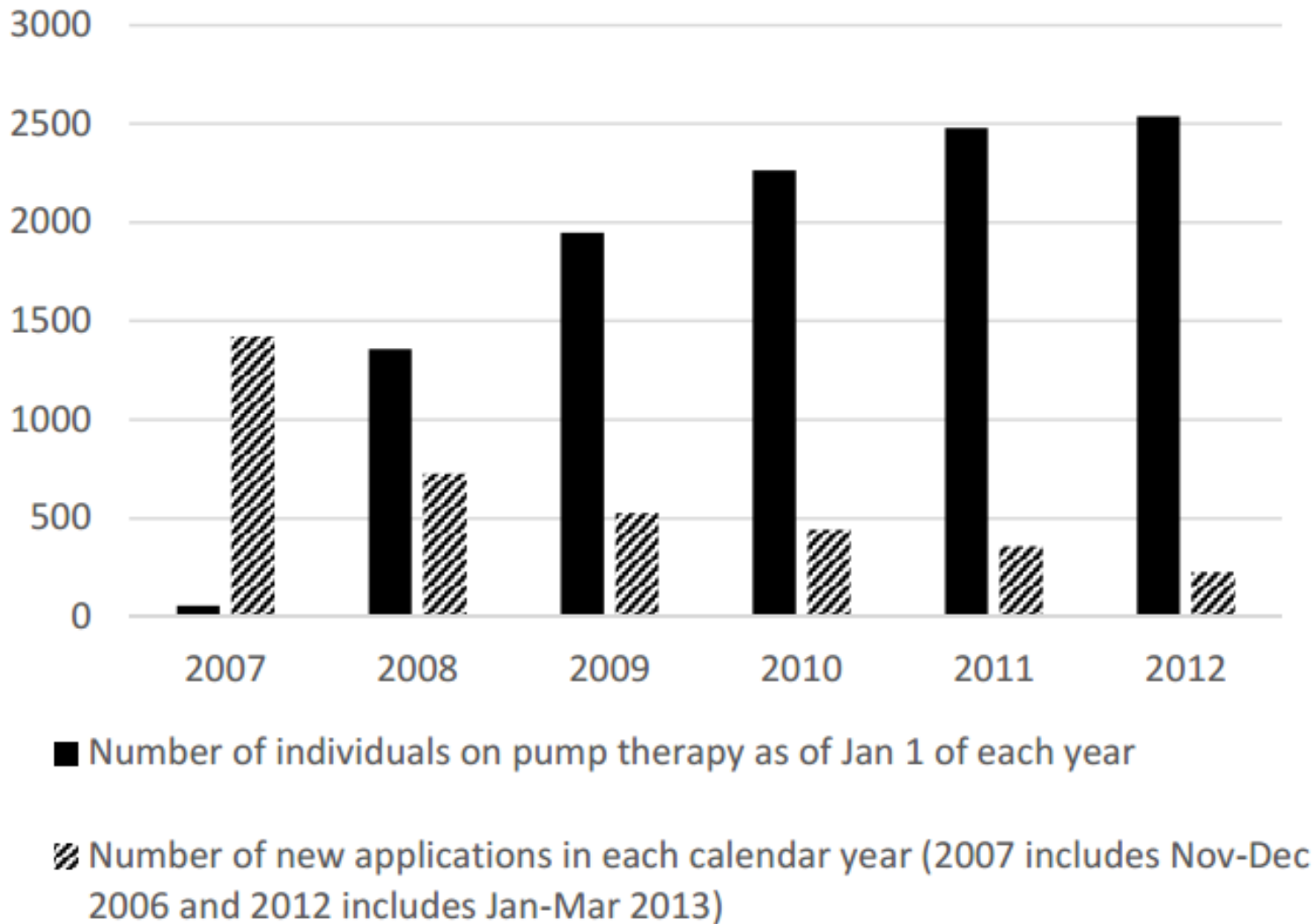
+ Background and Rationale

- High incidence of type 1 diabetes (T1D) in Canada (25.9/100,000/year)
- The Ontario Pediatric Diabetes Network (PDN) oversees care delivery
- Differences in PDN center characteristics (2012):
 - 24-hour support
 - Centre type
 - Physician model of care
 - Nursing patient load
- Universal funding for pediatric insulin pump therapy in Ontario since 2006



PDN Current State Survey 2013

Pump Use Following the Introduction of a Universal Funding Program in 2006



+ Background and rationale

- Diabetic ketoacidosis (DKA) can occur if pump fails
- 24-hour telephone support may prevent acute diabetes adverse events such as DKA
- Low socioeconomic status (SES) is associated with pediatric diabetes management and outcomes
- In Ontario, low-income children are less likely to use a pump
 - Shulman, R et al. *Pediatr Diabetes*. 2016 Jan 8



+ Objectives and Hypothesis



- To explore the relationship between 24-hour support, SES and
 - 1) The risk of DKA or death
 - 2) The rate of diabetes-related admissions and emergency department (ED) visits
- We hypothesized that lack of 24-hour support and lower SES would be associated with an increased risk of adverse events



Study Design and Data Sources



- Observational population-based cohort study
- All individuals <19 years with pump funding (2006-2011) followed until 2013
- PDN centre survey (2012)
 - Centre characteristics and resources
- Administrative Data (Institute for Clinical and Evaluative Sciences (ICES))
 - Assistive devices program (ADP)
 - Ontario Diabetes Database (ODD)
 - Hospitalizations and ED visits
 - Population and Demographic Data

+ Analyses



- Cox proportional hazards model: association between time to DKA or death and 24 hour support and deprivation
- Poisson model: association between the rate of diabetes-related ED visits or admissions and 24 hour support and deprivation
- Other variables
 - Centre-level: centre type, model of physician care, nursing patient load
 - Patient-level: Prior DKA, age, duration of T1D, baseline glycemic control, comorbid condition, and rurality
- Generalized estimating equations (GEE) used to account for patient clustering at centres

+ Baseline characteristics

	24-hour support available (n=1463)	No 24-hour support available (n=1730)
Deprivation Quintile, n (%)		
1 (least deprived)	529 (36.2%)	544 (31.5%)
2	401 (27.4%)	460 (26.6%)
3	257 (17.6%)	340 (19.7%)
4	164 (11.2%)	223 (12.9%)
5 (most deprived)	102 (7.0%)	150 (8.7%)
Missing	10 (0.7%)	13 (0.8%)
At least one DKA admission in 2 years prior to index date		
Yes	139 (9.5%)	252 (14.6%)
Centre type, n (%)		
Large community	748 (51.1%)	598 (34.6%)
Small community	72 (4.9%)	570 (33.0%)
Tertiary	643 (44.0%)	562 (32.5%)
Physician model, n (%)		
Generalist	323 (22.1%)	283 (16.4%)
Pediatric Endocrinologist	965 (66.0%)	981 (56.7%)
Visiting pediatric endocrinologist	175 (12.0%)	466 (26.9%)

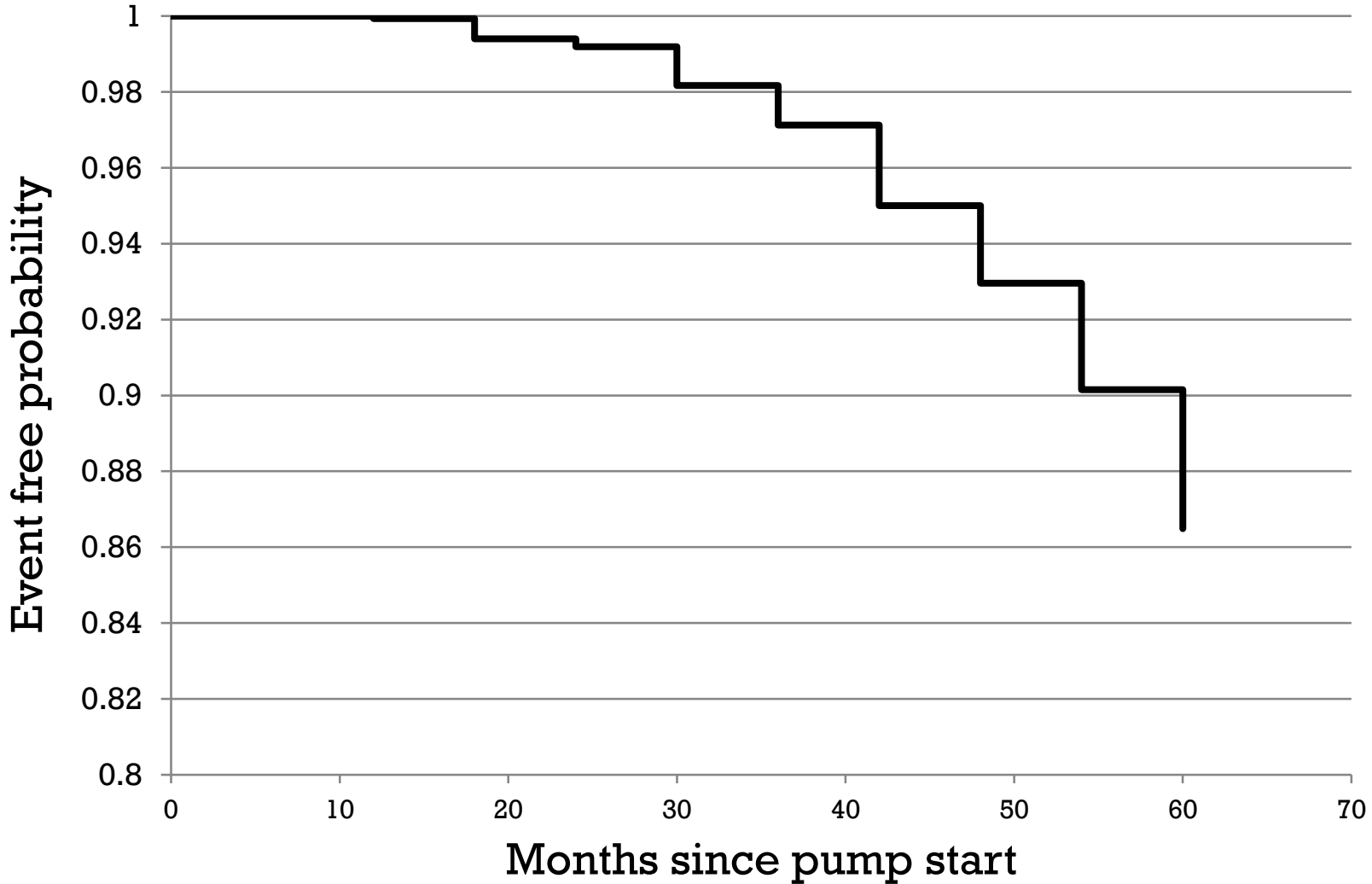
+ DKA or Death



- Mean time on pump was 3.77 years (SD 1.64)
- DKA rate: 5.28/100 person-years
 - Baseline DKA rate of 6.97/100 person-years
- <6 deaths
 - Death rate: 0.033/100 person-years



Cumulative Probability of DKA or death according to time since pump start



+ Time to first DKA or death (n=3193)

	DKA or death	
	Adjusted Hazard Ratio (95% CI)	p-value
Deprivation Quintile		
1 (least deprived) (n=1073)	(Ref) 1.0	
2 (n=861)	1.53 (1.22-1.91)	0.0002
3 (n=597)	0.96 (0.67-1.36)	0.8053
4 (n=387)	1.45 (1.07-1.95)	0.0161
5 (most deprived) (n=252)	1.58 (1.05-2.38)	0.0272
Missing (n=23)	1.87 (0.96-3.62)	0.0654
24 hr support		
No (n=1730)	(Ref) 1.0	
Yes (n=1463)	0.90 (0.73-1.10)	0.3023

+ Time to first DKA or death (n=3193)

	DKA or death	
	Adjusted Hazard Ratio (95% CI)	p-value
At least one DKA admission in 2 years prior to index date		
No (n=2802)	(Ref) 1.0	
Yes (n=391)	1.63 (1.28-2.07)	<0.0001
Baseline HbA1c		
<7.5% (n=718)	(Ref) 1.0	
7.5-9.0% (n=1845)	1.69 (1.31-2.18)	<0.0001
>9.0% (n=630)	2.63 (1.89-3.67)	<0.0001
Age group		
<6 th birthday (n=224)	0.88 (0.57-1.36)	0.5569
6 th -13 th birthday (n=1448)	(Ref) 1.0	
≥13 th birthday (n=1521)	2.35 (1.90-2.90)	<0.0001
Annual nursing patient load		
<200 (n=1283)	(Ref) 1.0	
≥200 (n=1910)	1.24 (1.00-1.52)	0.0468



Diabetes-related admissions or ED visits



- Rate of diabetes-related admissions and ED visits: 14.73/100 person-years
 - Baseline rate: 27.59/100 person years
- Being more deprived is associated with a higher rate of events (HR 1.60 (95% CI 1.27-2.00), $p < 0.0001$)
- 24-hour support was not significantly associated (HR 0.86 (95% CI 0.70-1.05), $p = 0.1265$)



Discussion: Adverse event rate



- Rate of DKA in Ontario pediatric pump users similar to other countries
 - Sweden (2000) (3.6/100 patient-years)
 - Hanas R. et al. *Pediatr Diabetes* 2009; 10:33-37
 - Europe and Israel (2004-2005) (6.26 /100 patient-years)
 - Danne T. et al. *Diabetologia* 2008; 51:1594-1601
- Risk DKA or death in first 2 years of pump use is low and rate of adverse events after pump start is lower compared to baseline



Discussion: 24 hour support



- Our results question previous work
 - 24-hour telephone care for T1D:
 - Prevents ED and office visits
 - Allen HF, et al. *Pediatr Diabetes* 2002; 3:95-100
 - Increases ED visits but decreases likelihood of hospitalization
 - Franklin BE, et al. *Diabetes Care* 2014; 37:81-87
- 24-hour support may not be an important service or barriers to its effective use may exist



Discussion: SES



- Our results support existing evidence for SES disparity in diabetes management and outcomes
- US Type 1 Diabetes Exchange clinic registry (n=13,487), low income is associated with a higher frequency of DKA
 - Cengiz, E. et al. *Pediatr Diabetes* 2013; 14:447-454
- In Ontario, children of lower SES are less likely to be using pumps
 - Shulman, R. et al. *Pediatr Diabetes*. 2016 Jan 8
- Single Ontario center: no association between deprivation and glycemic control in pump users
 - Zuijdwijk, C.S. et al. *J Pediatr* 2013; 162:730-735

+ Limitations



- We measured applications for pump funding, not actual pump use
- Some individuals who applied for pump funding may have been using a pump prior to universal funding
- HbA1c data is unavailable
- Self-reported nature of the centre data



Conclusions



- Implementation in Ontario not resulted in safety concerns
- Need to examine potential barriers and benefits of 24 hour support
 - Impact on parental anxiety
 - Reduction in disparity in SES of diabetes outcomes
- Need to further investigate underlying causes of SES disparities in the risk of DKA
 - Inform interventions aimed at reducing the inequity
- Targeted interventions for high risk groups may be beneficial

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