Moving Health Forward:
Understanding Consumer Health Risk from Location Trajectories

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Background : Hospitalization is costly - Mean cost per hospital stay $33,079 in 2016.

Prior Evidence : Among other factors, day-to-day lifestyle choices are critical to improving health outcomes and to reducing the cost of hospitalization.
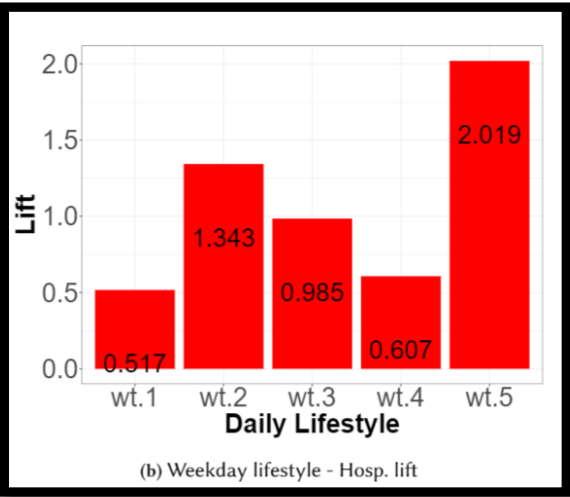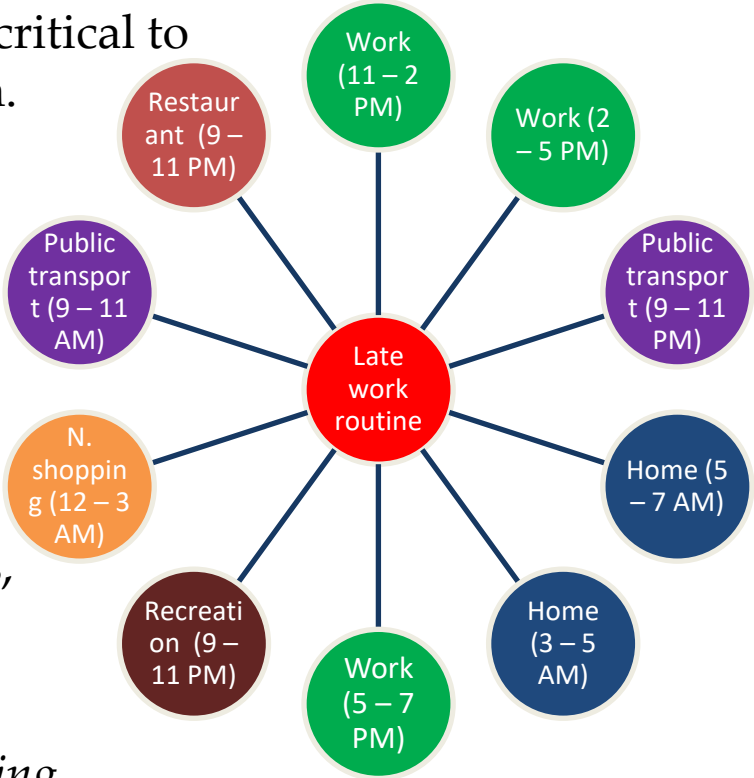
Rich behavioral data : Location data reveals patterns of individual's work, commute routine, consumption behavior and activities during leisure.

Proposed Framework

- **Lifestyle identification**: Identify activities that represent macro routines of day-day activities from location data.
- **Health risk** : Based on lifestyles and other micro day-day activities, we aim to predict if an individual has a health-related event

Data : 0.2 B location observations , 11K individuals, 4 months, 2 cities

Main Findings Identified lifestyles reveal *varying work routines, shopping, consumption and leisure patterns*, are *significantly associated* and *provide significant performance lift* for predicting health outcomes.

Work (11 − 2 PM)
Restaurant (9 − 11 PM)
Work (2 − 5 PM)
Public transport (9 − 11 AM)
Public transport (9 − 11 PM)
Late work routine
N. shopping (12 − 3 AM)
Home (5 − 7 AM)
Recreation (9 − 11 PM)
Home (3 − 5 AM)
Work (5 − 7 PM)

(b) Weekday lifestyle - Hosp. lift

Lift — Daily Lifestyle: wt.1 = 0.517, wt.2 = 1.343, wt.3 = 0.985, wt.4 = 0.607, wt.5 = 2.019

	Health event			
	(1)	(2)	(3)	(4)
Weekday lifestyle 1 (wt.1)	−0.685***	−0.691***	−0.665***	−0.614***
	(0.189)	(0.190)	(0.200)	(0.209)
Weekday lifestyle 2 (wt.2)	0.121	0.076	−0.204	−0.138
	(0.175)	(0.177)	(0.182)	(0.193)
Weekday lifestyle 4 (wt.4)	−0.494**	−0.463*	−0.429*	−0.395*
	(0.241)	(0.243)	(0.250)	(0.261)
Weekday lifestyle 5 (wt.5)	0.998***	1.030***	0.933***	0.946***
	(0.146)	(0.149)	(0.155)	(0.164)
Accessibility metrics	No	Yes	Yes	Yes
Mobility metrics	No	No	Yes	Yes
Social Demographics	No	No	No	Yes

Health event rate	2.45%	
Measure /Model	PR AUC	AUC
LSTM (No Lifestyle & activity features	0.15 (1.97%)	0.72 (1.60%)
LSTM (No Lifestyle features)	0.22 (1.05%)	0.79 (2.95%)
Full model	0.28 (1.53%)	0.85 (3.67%)