Economic Evaluation of a Screening Programme for Diabetes, Hypertension and Hyperlipidemia in Middle-Aged Adults in Hong Kong: A Simulation Analysis

EE307

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INTRODUCTION

The American Diabetes Association recommends screening for Type 2 diabetes and prediabetes in earlier age of 45 and above (1). In 2020, there are 2.3 million people aged 45-64 in Hong Kong, and according to the population health survey, around 9.7% of them have diabetes mellitus (DM), 36.1% have hypertension (HT), and 66.8% have hypercholesterolemia (HL) (2). Despite the high prevalence, the **undiagnosed rates** of the three diseases are high in these people, at around 65.3% for DM, 49.2% for HT and 71.1% for HL (Fig1).

In November 2023, Hong Kong government has initiated the **Chronic Disease Co-Care Pilot Scheme** in district health centers, providing screening services and tailored health management plan on DM and HT for residents aged 45 and above. It's expected that the timely screening and treatment for the three common chronic diseases (DM, HT, HL) in middle-aged adults can bring tremendous clinical and economic value for patients, as well as the health and social systems.

Fig 1. Prevalence of DM/HT/HL in Middle-aged Adults

Adults aged 45-64 in Hong Kong	Diabetes Mellitus	Hypertension	Hyperlipemia
Prevalence	9.7%	36.1%	66.8%
- Previously diagnosed	3.1%	18.3%	19.3%
- Previously undiagnosed	5.8%	17.7%	47.5%

OBJECTIVES

This study aimed to evaluate the effectiveness and **cost-effectiveness** of implementing a **screening program** for diabetes mellitus, hypertension and hyperlipidemia among middle-aged adults aged 45-64 in the local context of Hong Kong.

STUDY DESIGN

This was a **micro-simulation analysis** based on a state-transition Markov Monte Carlo simulation model named **CDC-RTI Diabetes** Cost-Effectiveness Model (3). This model was adapted to the local use in Hong Kong, and incorporated screening module and disease progression module (Fig2).

- **Screening module** stimulated early detection for DM/HT/HL, which offset a 5-year time lag between onset and diagnosis in routine care.
- **Disease progression module** simulated the natural history of DM, HT and HL, with occurrence of complications of neuropathy, nephropathy, stroke, coronary heart disease and retinopathy.

MATERIALS & METHODS

- **Participants**: a closed cohort of 2.2 million people aged 45-65 without a historical diagnosis of DM or lipid disorder in community in Hong Kong.
- **Interventions**: one-off screening for DM, HT and HL, versus no screening program.
- **Time horizon**: lifetime (at a cap of 100-year-old), with an annual discount rate of 3%.
- **Perspective**: public health care system.
- **Data source:** population demographics, disease progression, costs and effectiveness of screening and treatments were derived from Census Statistics and local published literatures (4-8).
- **Outcomes of interest**: i) newly detected cases, ii) life year and quality-adjusted life year gained (QALYs), iii) occurrence of disease-related complications, iv) death due to complications, and v) incremental cost-effectiveness ratios (ICERs) for different outcomes.

Fig 2. CDC-RTI Diabetes Cost-Effectiveness Model

Module 1. Screening module
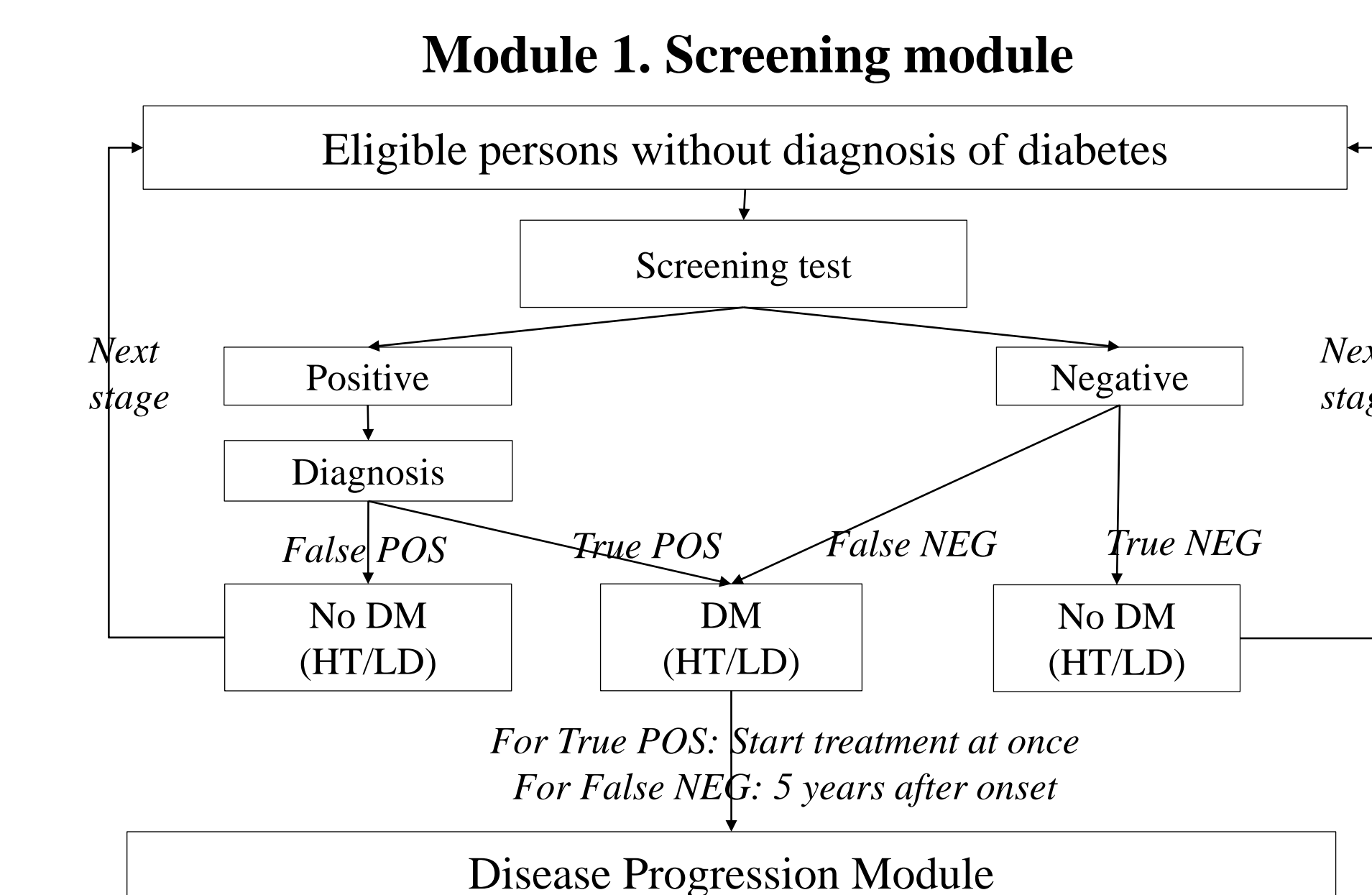
Module 2. Disease progression module
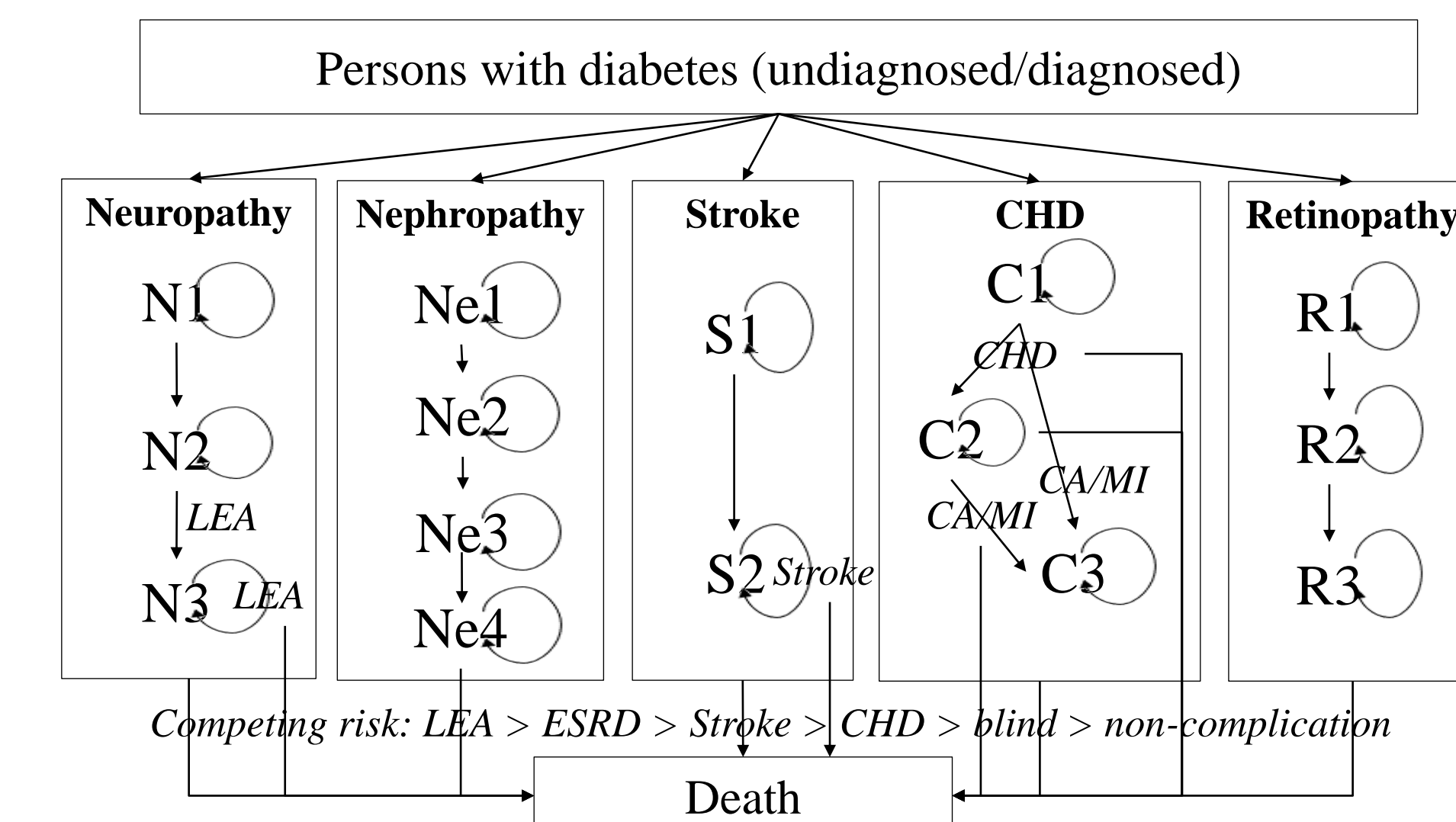
- **Neuropathy**: N1, no neuropathy; N2, Peripheral neuropathy; N3, history of lower-extremity amputation (LEA)
- **Nephropathy**: Ne1, no nephropathy; Ne2, low or high microalbuminuria; Ne3, clinical nephropathy; Ne4, End-stage renal disease
- **Stroke**: S1, no stroke; S2, history of stroke
- **Coronary Heart Disease (CHD)**: C1, no CHD; C2, angina; C3, history of cardiac arrest (CA) or myocardial infarction (MI)
- **Retinopathy**: R1, no retinopathy; R2, Photocoagulation; R3, blind

RESULTS

One-off screening versus No screening:
- **New DM cases** detected: 54,529
- **Number of tests and costs** required to detect a new case: 40 tests or US$3,939
- **Incremental cost:**+US$0.84 billion ($2780/person)
  - **Extra** cost of screening: +$0.23 billion
  - **Extra** cost of earlier treatment: +$0.79 billion
  - **Saving** in complications: -$0.19 billion
  - **Saving** in DM-related death: -$4.5 million
- **Effectiveness** of screening program**:**
  - **Survival years** per DM patient:+0.26
  - **Life-year/ QALY** per participant:+0.059/ +0.028
  - **Myocadiac infarction**: -4,415 cases
  - **Stroke**: -5,403 cases
  - **Microalbuminuria**: -5,403 cases
  - **Angina**: -2,688 cases
  - **Death** caused by complication: -6,105 cases
- **ICERs**: $42,483 per life-year gained; $89,485 per QALY gained.

Fig 3. Cost-effectiveness of One-off Screening

Total population (2.2 million)	No screening	One-off screening
Total cost (US$ billion)	**42.51**	**43.34**
- Screening cost	0	0.22
- Routine care	6.46	7.26
- Treating complication	5.94	5.75
- Death-related cost	30.11	30.10
Per person cost (US$)	**62,872**	**65,214**
- Screening cost	0	751
- Routine care	21,423	24,105
- Treating complication	19,716	19,077
- Death-related cost	99,903	99,888
Effectiveness		
- Newly detected cases	0	54,529
- Survival year per DM case	10.55	10.81
- Life years per person	30.58	30.63
- QALY per person	19.01	19.03
- Death due to complication	252,734	246,629
Incidence rate (patients)		
- Myocadiac infarction	0.033	0.031
- Stroke	0.044	0.042
- Microalbuminuria	0.420	0.424
- Photocoagulation	0.079	0.077
- Angina	0.194	0.189

CONCLUSIONS

Implementation of early screening program for diabetes mellitus, hypertension and lipid disorders among general middle-aged adults **is acceptable and recommended in both clinical and economic aspects** in Hong Kong.

- Extra cost of screening mainly derives from screening practice and he subsequent care, while savings are from reduced risk of complications.
- Early screening and timely treatment can prolong survival years and quality of life of patients, as well as preventing early death.
- Occurrence of adverse event also decreases due to timely disease management, reducing burden and saving resources for health care system.

REFERENCES

1. Davidson KW, et al. Screening for prediabetes and type 2 diabetes: US Preventive Services Task Force recommendation statement. Jama. 2021;326(8):736-743.
2. Centre for Health Protection DoH. Report of Population Health Survey 2014/2015. 2017. Accessed 09 Sep 2021.
3. Hoerger TJ, et al. Screening for type 2 diabetes mellitus: a cost-effectiveness analysis. Annals of Internal Medicine. 2004;140(9):689-699.
4. Cheung BM, et al. Association between raised blood pressure and dysglycemia in Hong Kong Chinese. Diabetes Care. 2008;31(9):1889-1891.
5. Jiao F, et al. Long-term effects of the multidisciplinary risk assessment and management program for patients with diabetes mellitus (RAMP-DM): a population-based cohort study. Cardiovascular diabetology. 2015;14(1).
6. Jiao FF, Fung CSC, Wan EYF, et al. Five-year cost-effectiveness of the multidisciplinary Risk Assessment and Management Programme–Diabetes Mellitus (RAMP-DM). Diabetes Care. 2018;41(2):250-257.
7. Shao H, et al. Influence of diabetes complications on HbA1c treatment goals among older US adults: a cost-effectiveness analysis. Diabetes care. 2019;42(11):2136.
8. Yu EY, et al. Effects of risk assessment and management programme for hypertension on clinical outcomes and cardiovascular disease risks after 12 months: a population-based matched cohort study. Journal of hypertension. 2017;35(3):627.
9. Quan J, Li T, Pang H, et al. Diabetes incidence and prevalence in Hong Kong, China during 2006–2014. Diabetic medicine. 2017;34(7):902-908.

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