National Healthcare Group

Adding years of healthy life

# Diabetic Foot in Primary and Tertiary (DEFINITE) Care

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## Mission Statement

DEFINITE Care is an inter-institutional and multi-disciplinary team (MDT) health systems innovation within NHG. It aims to achieve coordinated MDT care across primary and tertiary care for patients with Diabetic Foot Ulcer (DFU). The 4 workplans of DEFINITE Care are to (1) scale up existing primary care DM Foot Screening and Surveillance, Treatment, Escalation Programme for ulcer prevention (DM Foot STEP) and tertiary care MDT-style Lower Extremity Amputation Prevention Program (LEAPP) clinics, (2) closed-loop coordination of care between primary and tertiary institutions, (3) adoption of a patient-centric and patient-owned digital wound imaging app and (4) health economics analysis to evaluate cost effectiveness and long-term financial sustainability of the programme

## Core Team Members

| | Name | Designation | Department |
|---|---|---|---|
| Program Director | Dr. Joseph Lo | Consultant | Surgery, WH |
| Institution Leads | Dr. Elaine Tan | Associate Consultant | NHGP (Toa Payoh) |
| | Dr. Liew Huiling | Consultant | Endocrinology, TTSH |
| | Dr. Desmond Ooi | Senior Consultant | General Surgery, KTPH |
| | Dr. Hoi Wai Han | Senior Consultant | Medicine, WH |
| Program Evaluation | Dr Gary Ang (Consultant), HSOR | | |
| Podiatrists | Chelsea Law (KTPH), Pauline Ang (NHGP), Tiffany Chew (TTSH) | | |
| Program Manger | Ms. Rose Low | | Group Integrated Care |
| DM Foot Coordinators | Ms Koo Hui Yan, Ms Julia Choo, Mr Low Kai Qiang | | |

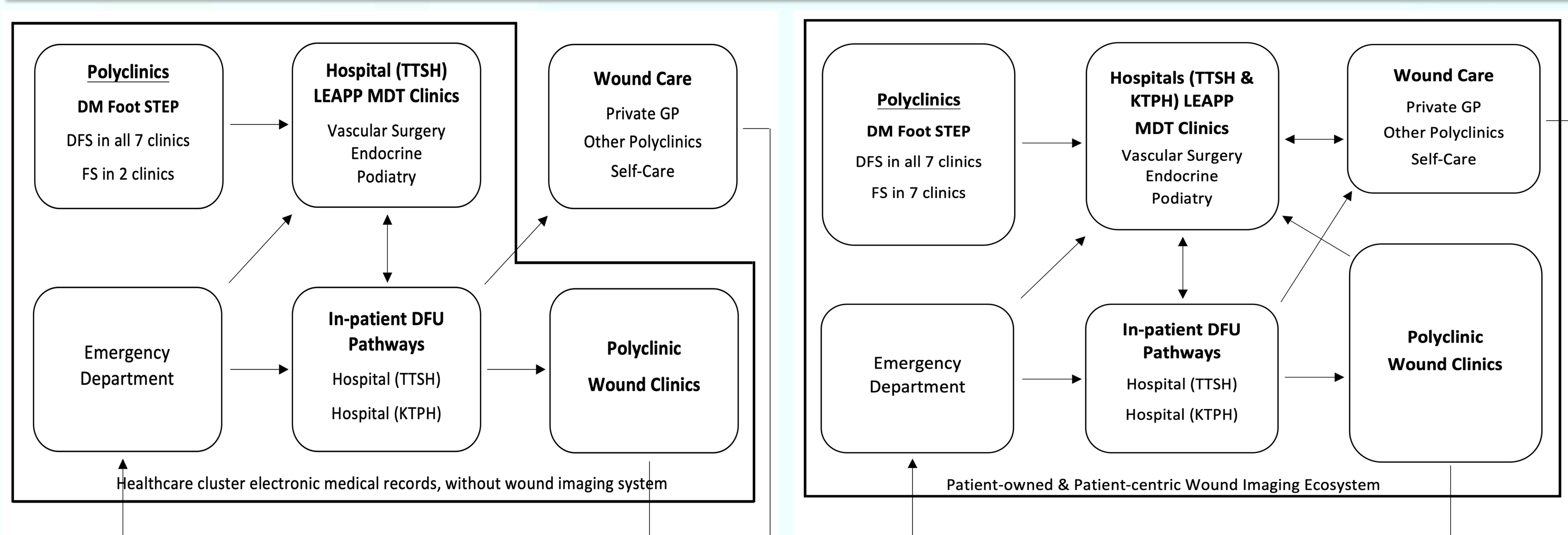
## Evidence for a Problem Worth Solving

- 1 in 3 patients with diabetes are at risk of developing DFU [1] and Singapore has three times the OECD average of DM-related lower extremity amputations (LEA) [2]
- In Singapore, there is an estimated ~1,500 DM-related LEA each year (average of 4 per day) [3]
- This is associated with a heavy economic burden of disease, with estimated gross healthcare cost per patient for hospital care (inpatient and specialist outpatient) and primary care at USD $16,920 in 2017 [4]. For patients who present with DFU-only, eventual minor LEA and major LEA, their mean cost per patient-year was USD $3368, $10,468 and $30,131 respectively [5]

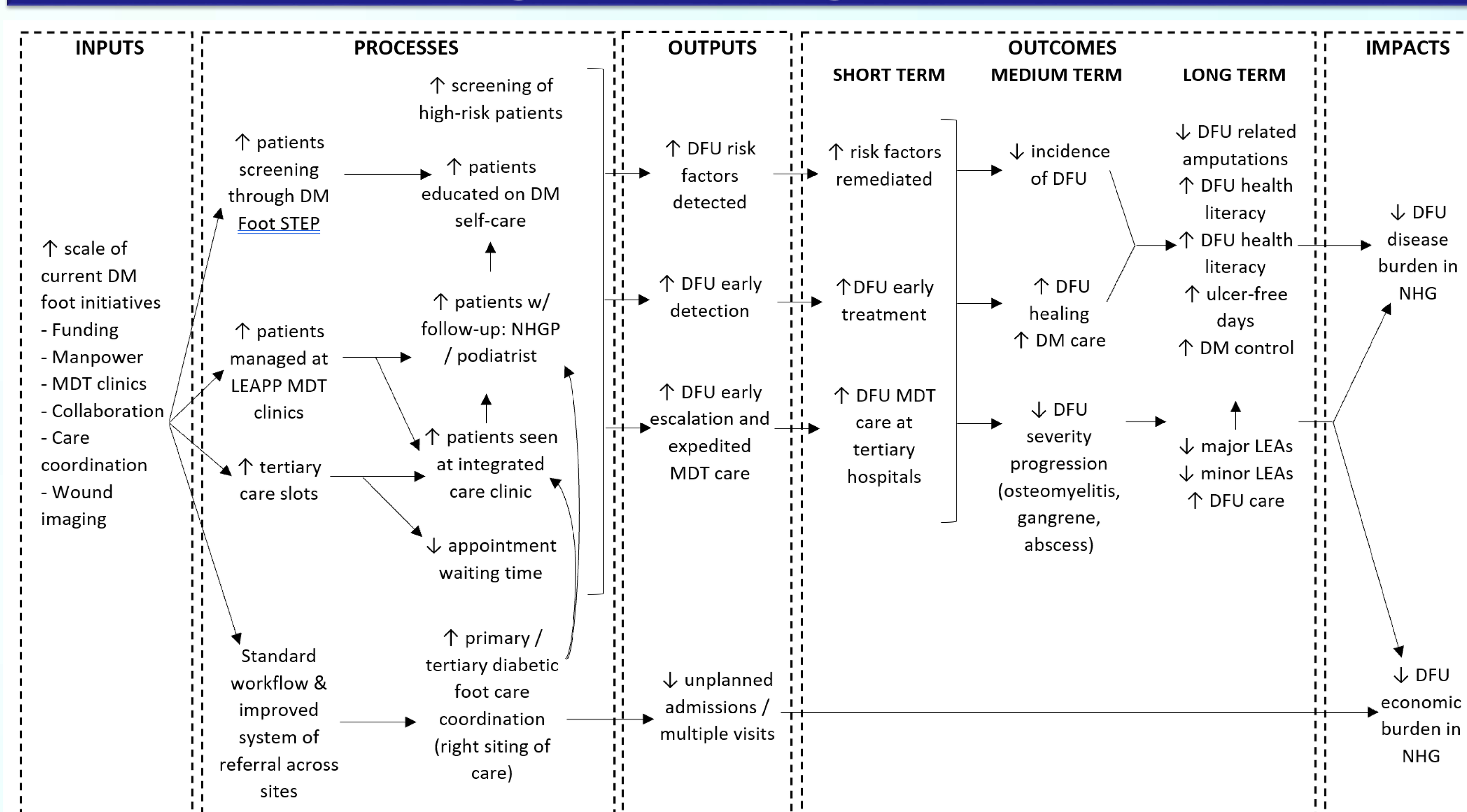
## Current Performance of a Process

- Retrospective data from 2013-2017 showed a high clinical and economic burden of DFU, with incidence of minor amputation at 36.4% and major amputation at 6.5% [5]
- Within NHG, the Diabetic Foot Workgroup convened in 2017 identified health services deficiencies for DFU care, which included variability in diabetic foot screening (DFS) rates across different primary care polyclinics, lack of uniformity in provision of the rapid access MDT LEAPP clinic services for patients referred from primary care to tertiary care, high patient default rates, lack of a wound imaging system within our electronic medical records system and lack of coordination across primary and tertiary care with respect to co-managed patients post diabetic limb salvage procedures from the hospitals

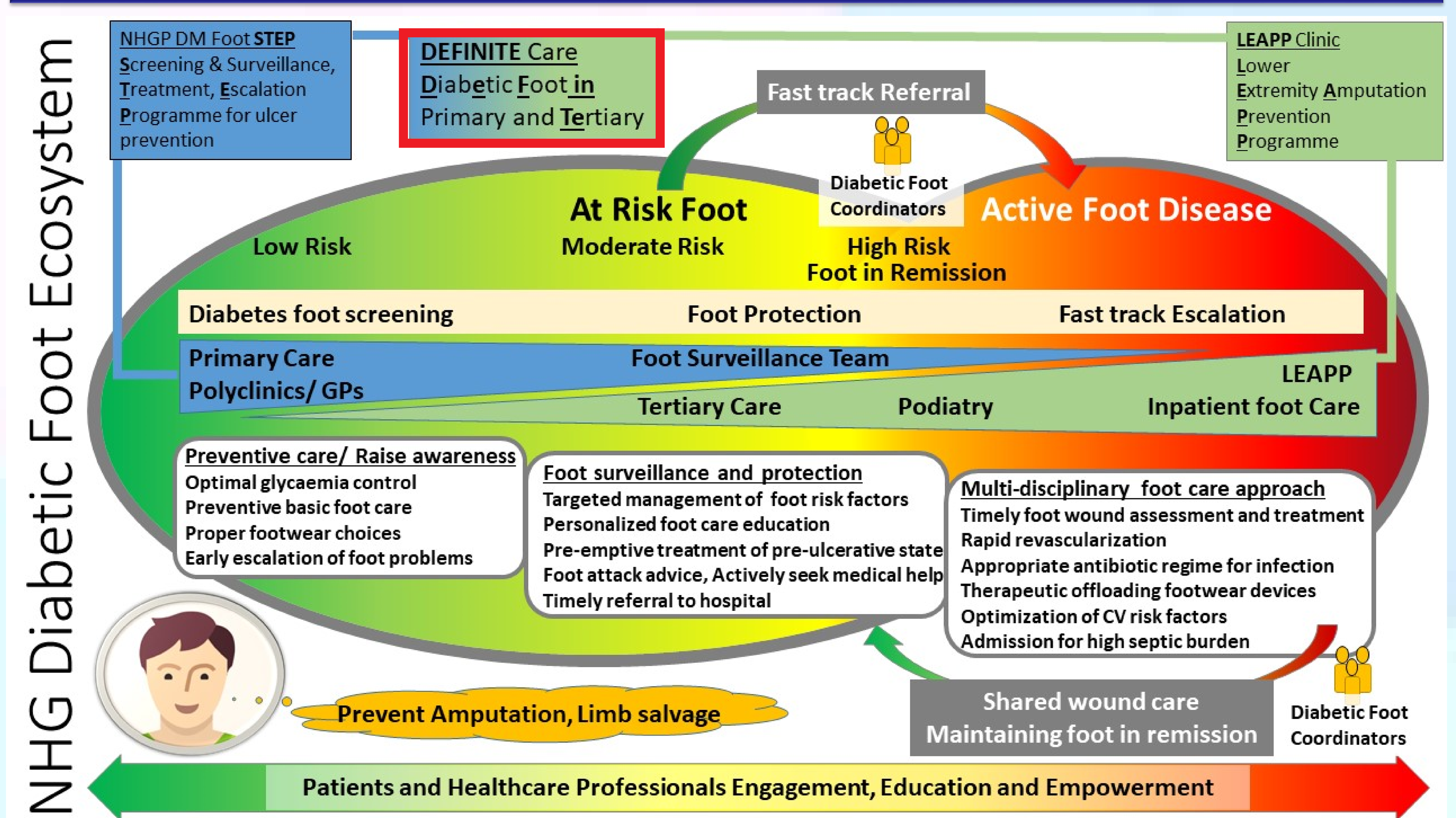
## Flow Chart of Process (Before/After)




## Programme Logic Model




## Implementation Ecosystem




## Results

Between June 2020 and December 2021, there were 3,475 unique patients with DFU with mean age at 65.9 (SD 12.9) years, 61.2% male, mean baseline HbA1c at 8.3% (SD 2.1) with mean diabetes duration at 13.3 (SD 8.8) years, mean diabetes complication severity index (DCSI) at 5.6 (SD 2.7) and mean Charlson Comorbidity Index (CCI) at 6.8 (SD 3.1).

| Outcomes | DEFINITE Care (Jun 2020-Dec 2021) (n=3,475) | Retrospective (2013-2017) (n=1,729) | p value |
|---|---|---|---|
| Minor LEA, n (%) | **302 (8.7)** | **630 (36.4)** | 0.0001 |
| Major LEA, n (%) | **176 (5.1)** | **113 (6.5)** | 0.0338 |
| 1-year mortality, n (%) | 255 (9.1) | 107 (6.2) | 0.1326 |

| Cardiovascular Profile (95% CI) | Pre-DEFINITE Care | Post-DEFINITE Care | p value |
|---|---|---|---|
| Mean HbA1c, % (n=2,083) | **8.4 (8.3-8.4)** | **7.9 (7.8-7.9)** | 0.0001 |
| Mean BMI, kg/m² (n=1,730) | 27.0 (26.7-27.2) | 27.0 (26.7-27.2) | 0.3040 |
| Mean LDL, mmol/L (n=1,243) | **2.2 (2.2-2.3)** | **2.1 (2.1-2.2)** | 0.0001 |
| Mean TC, mmol/L (n=1,134) | **4.1 (4.0-4.2)** | **3.9 (3.9-4.0)** | 0.0001 |
| Mean TG, mmol/L (n=1,134) | **1.7 (1.7-1.8)** | **1.6 (1.6-1.7)** | 0.0016 |

## Cost Savings

- A pilot case-cohort study in 2018 on the clinical and economic outcomes of a MDT approach in DFU management (LEAPP Clinic) demonstrated a significant decrease in mean time from referral to index clinic visit (38.6 to 9.5 days, $p < 0.001$), increase in outpatient podiatry follow-up (33% to 76%, $p < 0.001$), decrease in 1-year minor LEA rate (14% to 3%, p=0.007) and decrease in 1-year major LEA rate (9% to 3%, p=0.05) [6]
- Simulation of cost avoidance demonstrated an annualised cost avoidance of USD $1.86 million for patients within the LEAPP cohort and we expect direct healthcare costs savings within DEFINITE to be similar/higher

## Problems Encountered

- High defaulter rates: the average defaulter rate from July 2020 to June 2021 for TTSH and KTPH is 17.3% and 14.2% respectively
- To improve patient-carer health literacy with engagement, education and empowerment
- To develop standardized patient education resources
- Manpower resource challenges: shortage of Podiatrists trained in DFU care ; hiring of suitable candidates for the role of Diabetic Foot Coordinator
- Continual engagement of clinical staff and senior management to ensure buy-in and program endorsement

## Strategies to Sustain

- With more than 60 healthcare professionals across disciplines and institutions within DEFINITE Care team, we organise bi-monthly Clinical Review Meetings and quarterly Journal Clubs sessions to review our progress and share evidence-based practices and knowledge respectively
- In collaboration with HSOR and as part of the 3-year program, we will further perform sub-group analysis to enable targeted interventions for risk-stratified population and demonstrate the long-term financial sustainability through health economics analysis
- To foster stronger collaboration with primary care partners (e.g. CN-PCN team, community Nursing, GPs), community partners (e.g. Diabetes Society, NTUC Health, 7 Vision) and other National DM-related programmes (e.g. SiDRP, HALT-CKD, NPSC National DM Collaborative)
- The team will aim to eventually involve patient representatives (patients with healed DFU and patients with major amputation), for a more balanced and patient-centric team

**References**

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3. Ang Y, Yap CW, Saxena N, et al. Diabetes-related lower extremity amputations in Singapore. Proceedings of Singapore Healthcare. 2017;26(2):76-80.
4. Lo ZJ, Lim X, Eng D, et al. Clinical and economic burden of wound care in the tropics: a 5-year institutional population health review. Int Wound J. 2020; 17:790–803.
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6. Lo ZJ, Chandrasekar S, Yong E, et al. Clinical and economic outcomes of a multidisciplinary team approach in a lower extremity amputation prevention programme for diabetic foot ulcer care in an Asian population: A case-control study. Int Wound J. 2022 May; 19(4): 765-773